FIG.1

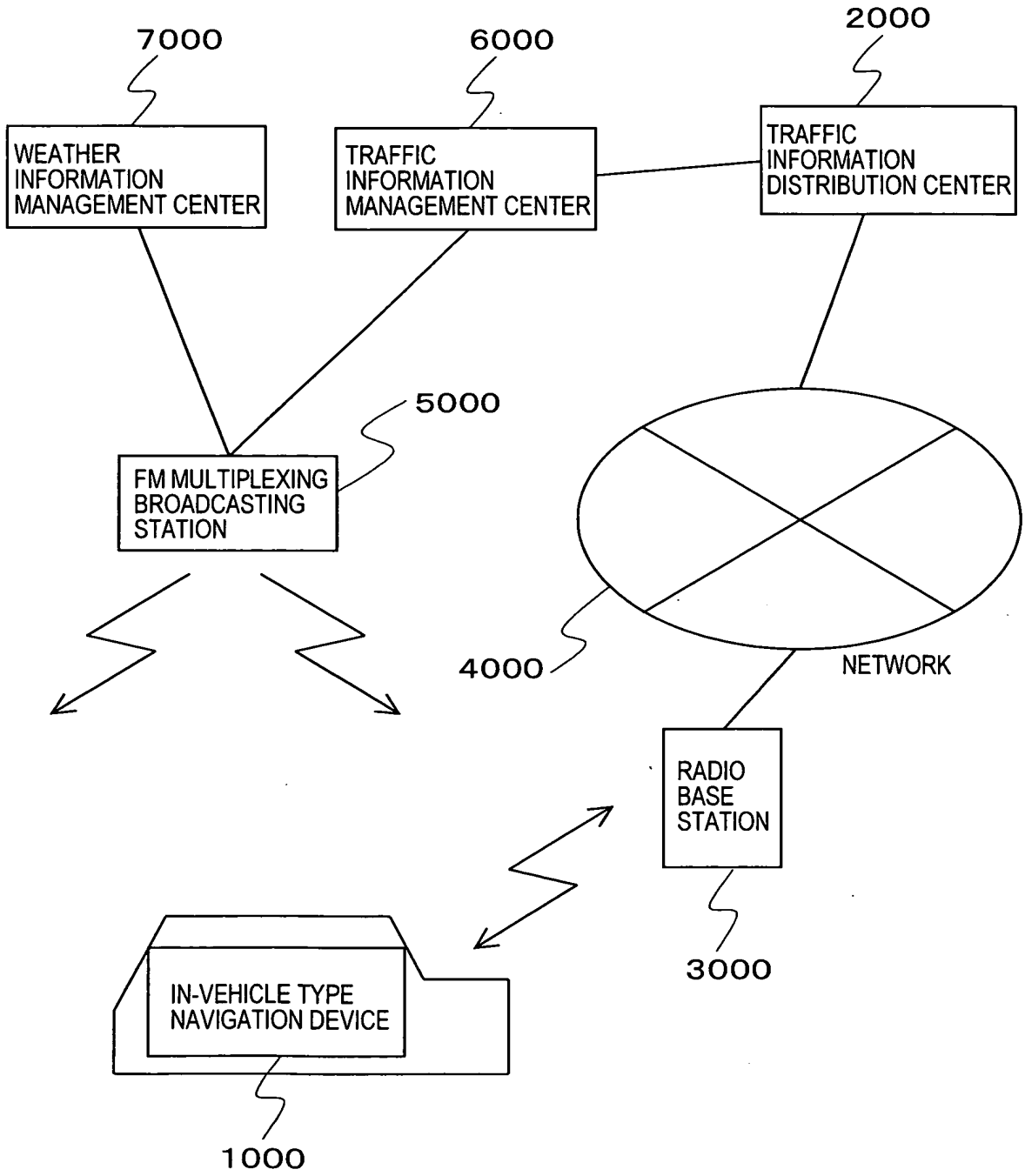

7000
6000
2000
WEATHER INFORMATION MANAGEMENT CENTER
TRAFFIC INFORMATION MANAGEMENT CENTER
TRAFFIC INFORMATION DISTRIBUTION CENTER
5000
FM MULTIPLEXING BROADCASTING STATION
4000
NETWORK
RADIO BASE STATION
3000
IN-VEHICLE TYPE NAVIGATION DEVICE
1000

FIG.2

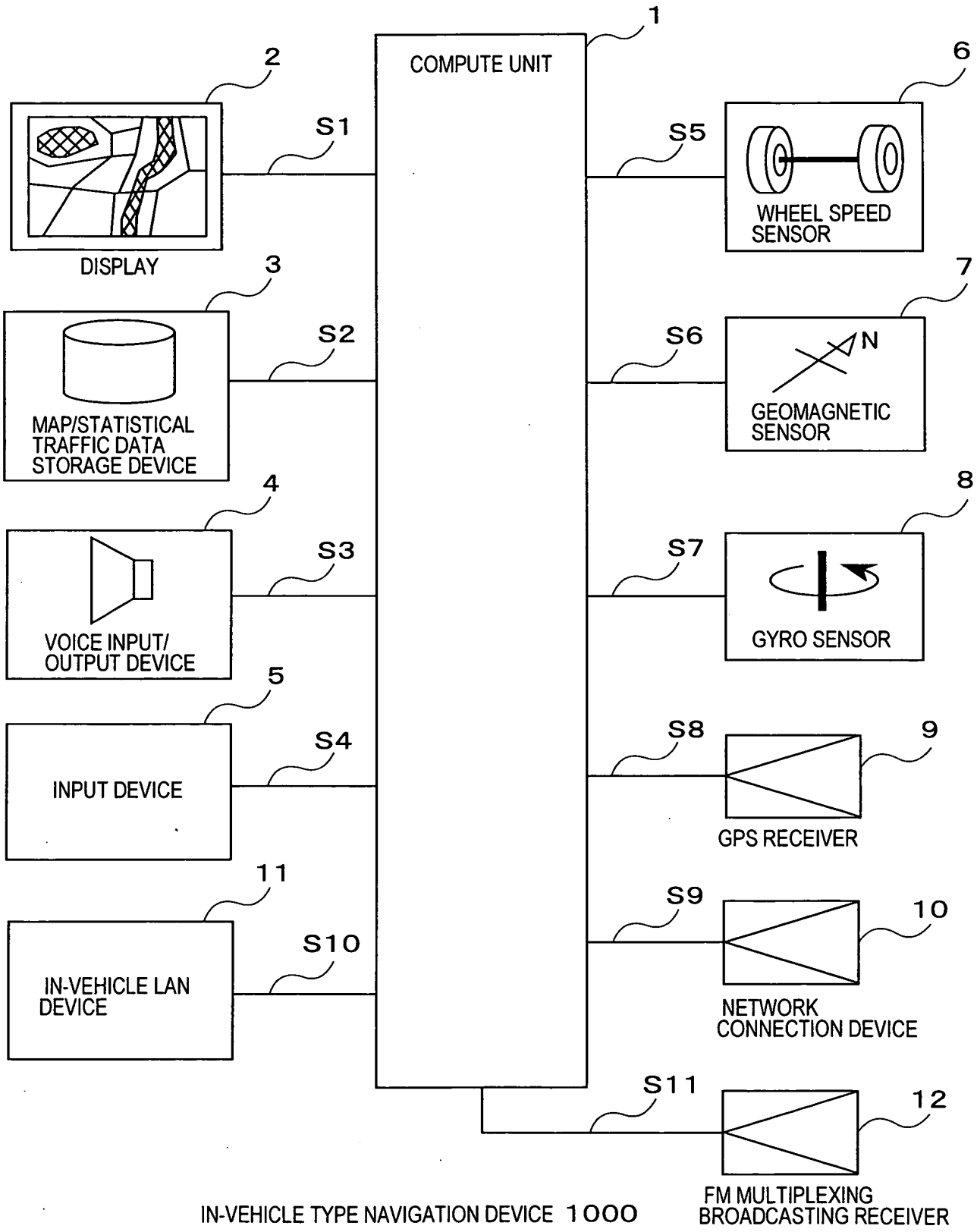

1
COMPUTE UNIT
2
DISPLAY
S1
3
MAP/STATISTICAL TRAFFIC DATA STORAGE DEVICE
S2
4
VOICE INPUT/ OUTPUT DEVICE
S3
5
INPUT DEVICE
S4
11
IN-VEHICLE LAN DEVICE
S10
S5
6
WHEEL SPEED SENSOR
S6
7
N
GEOMAGNETIC SENSOR
S7
8
GYRO SENSOR
S8
9
GPS RECEIVER
S9
10
NETWORK CONNECTION DEVICE
S11
12
FM MULTIPLEXING BROADCASTING RECEIVER
IN-VEHICLE TYPE NAVIGATION DEVICE 1000

FIG.3

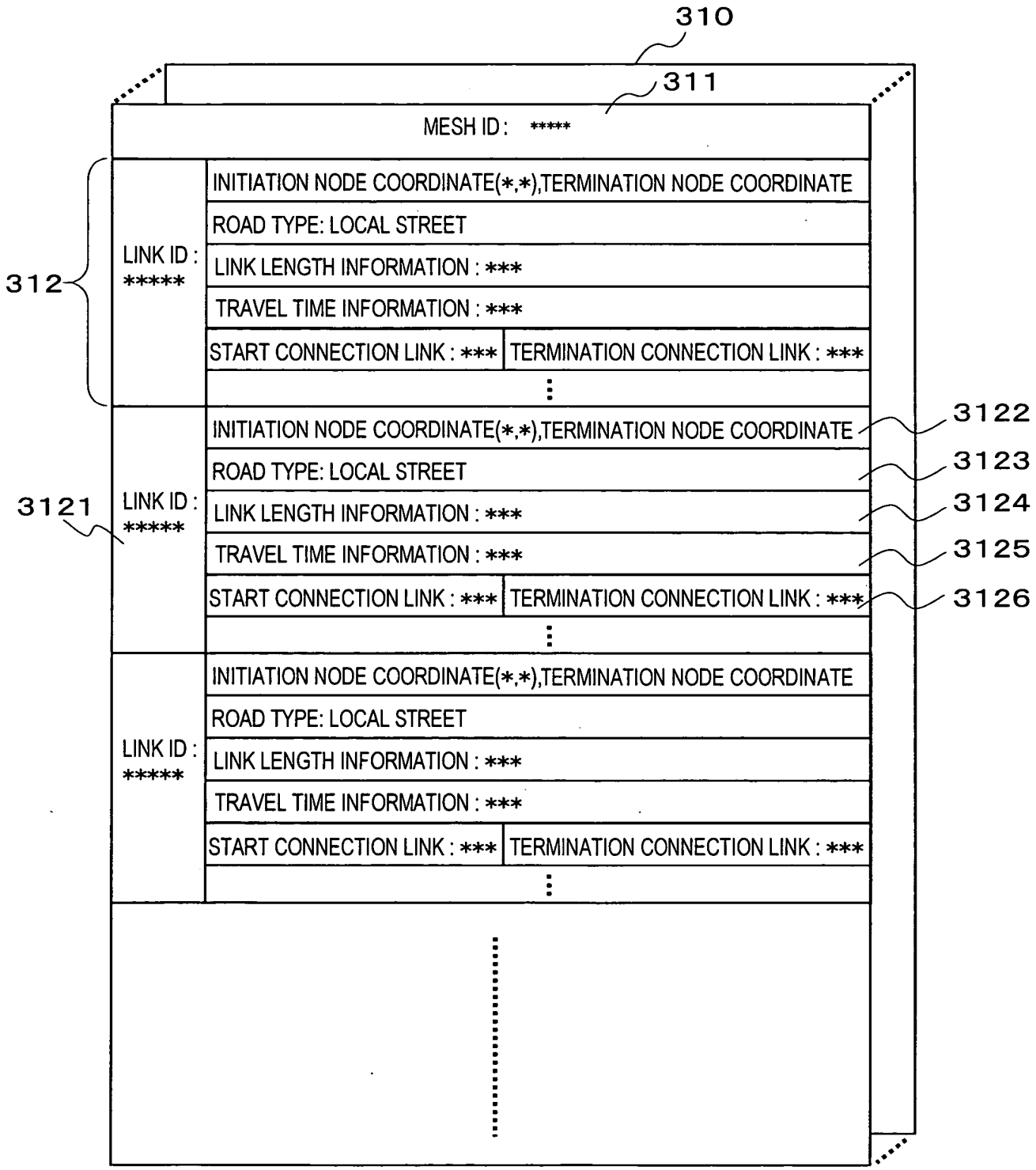

310
311
MESH ID: *****
312
LINK ID : *****
INITIATION NODE COORDINATE(*,*),TERMINATION NODE COORDINATE
ROAD TYPE: LOCAL STREET
LINK LENGTH INFORMATION : ***
TRAVEL TIME INFORMATION : ***
START CONNECTION LINK : ***
TERMINATION CONNECTION LINK : ***
3121
LINK ID : *****
INITIATION NODE COORDINATE(*,*),TERMINATION NODE COORDINATE
ROAD TYPE: LOCAL STREET
LINK LENGTH INFORMATION : ***
TRAVEL TIME INFORMATION : ***
START CONNECTION LINK : ***
TERMINATION CONNECTION LINK : ***
3122
3123
3124
3125
3126
LINK ID : *****
INITIATION NODE COORDINATE(*,*),TERMINATION NODE COORDINATE
ROAD TYPE: LOCAL STREET
LINK LENGTH INFORMATION : ***
TRAVEL TIME INFORMATION : ***
START CONNECTION LINK : ***
TERMINATION CONNECTION LINK : ***

FIG.4

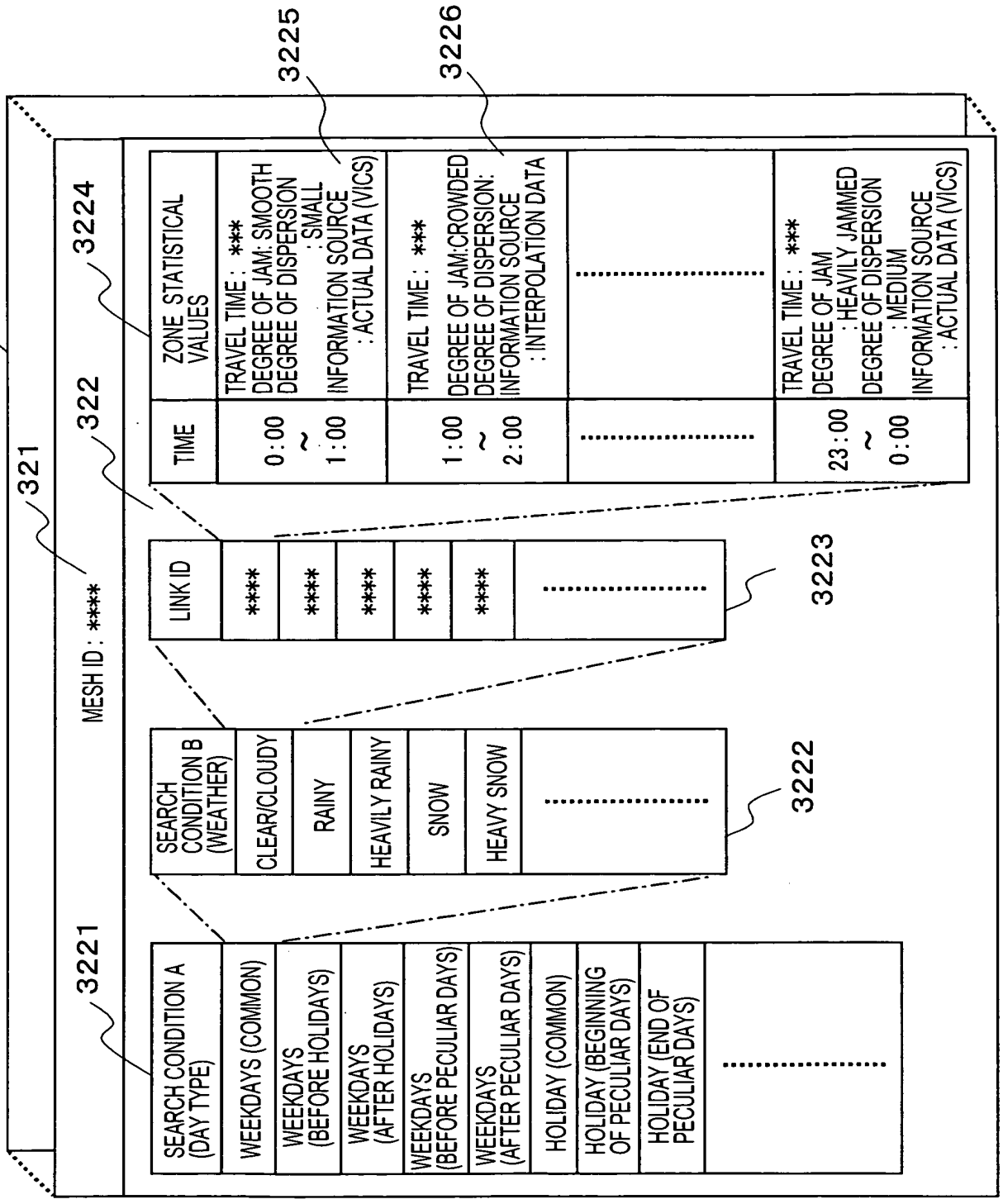

320
321
MESH ID: ****
322
3221
SEARCH CONDITION A (DAY TYPE)
WEEKDAYS (COMMON)
WEEKDAYS (BEFORE HOLIDAYS)
WEEKDAYS (AFTER HOLIDAYS)
WEEKDAYS (BEFORE PECULIAR DAYS)
WEEKDAYS (AFTER PECULIAR DAYS)
HOLIDAY (COMMON)
HOLIDAY (BEGINNING OF PECULIAR DAYS)
HOLIDAY (END OF PECULIAR DAYS)
3222
SEARCH CONDITION B (WEATHER)
CLEAR/CLOUDY
RAINY
HEAVILY RAINY
SNOW
HEAVY SNOW
3223
LINK ID
****
****
****
****
****
3224
TIME
ZONE STATISTICAL VALUES
0:00 ~ 1:00
TRAVEL TIME: ***
DEGREE OF JAM: SMOOTH
DEGREE OF DISPERSION : SMALL
INFORMATION SOURCE : ACTUAL DATA (VICS)
3225
1:00 ~ 2:00
TRAVEL TIME: ***
DEGREE OF JAM:CROWDED
DEGREE OF DISPERSION: :
INFORMATION SOURCE : INTERPOLATION DATA
3226
23:00 ~ 0:00
TRAVEL TIME: ***
DEGREE OF JAM : HEAVILY JAMMED
DEGREE OF DISPERSION : MEDIUM
INFORMATION SOURCE : ACTUAL DATA (VICS)

FIG.5

331 332

DATE	SEARCH CONDITION A (DAY TYPE)
2002 /11 /28	WEEKDAYS (COMMON)
2002 /11 /29	WEEKDAYS (BEFORE HOLIDAYS)
2002 /11 /30	HOLIDAY (COMMON)
2002 /12 /01	HOLIDAY (COMMON)
2002 /12 /02	WEEKDAYS (AFTER HOLIDAYS)
2002 /12 /03	WEEKDAYS (COMMON)
⋮	⋮

FIG.6

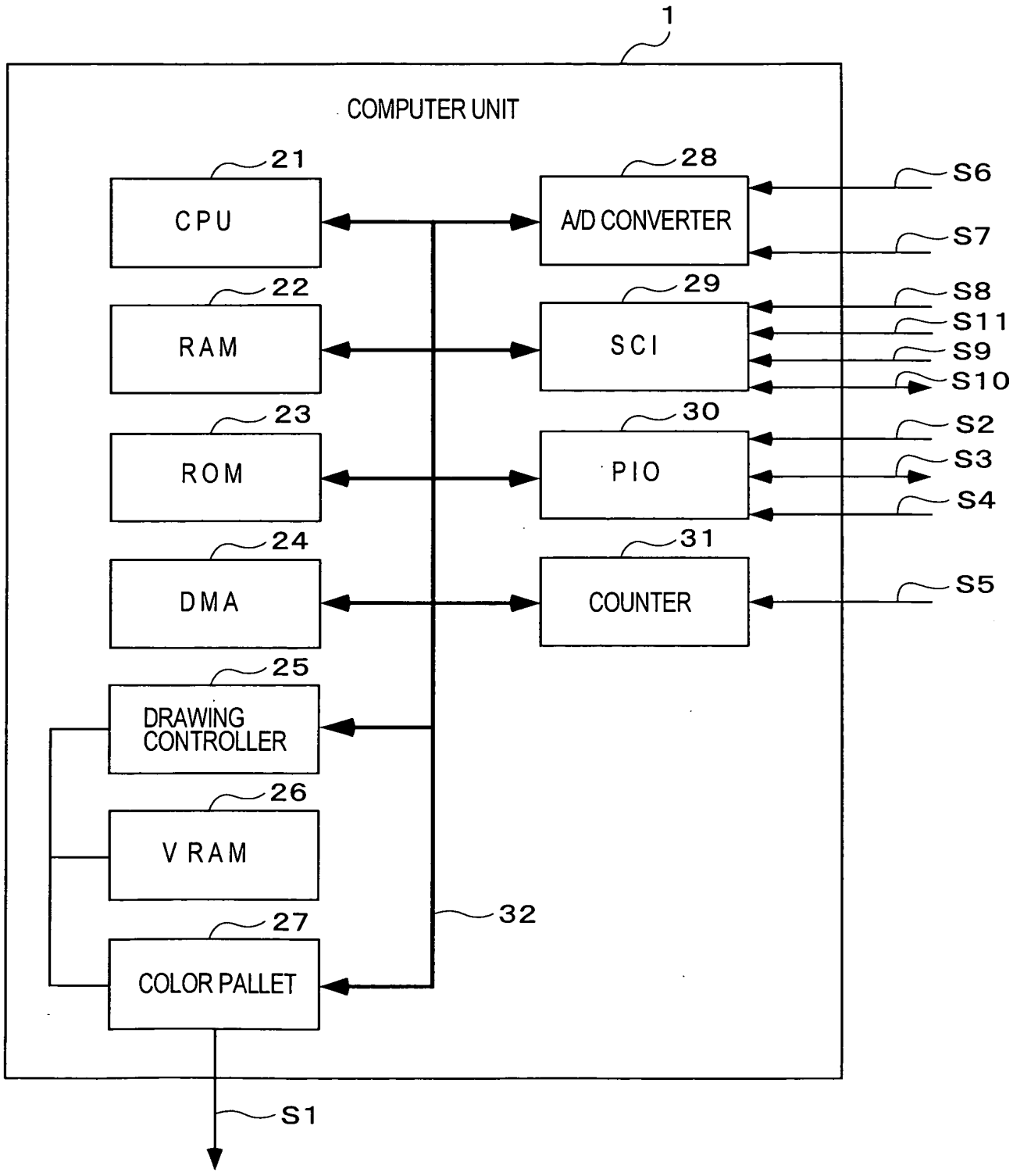

1
COMPUTER UNIT
21
CPU
22
RAM
23
ROM
24
DMA
25
DRAWING CONTROLLER
26
V RAM
27
COLOR PALLET
28
A/D CONVERTER
29
SCI
30
PIO
31
COUNTER
32
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
S11

FIG.7

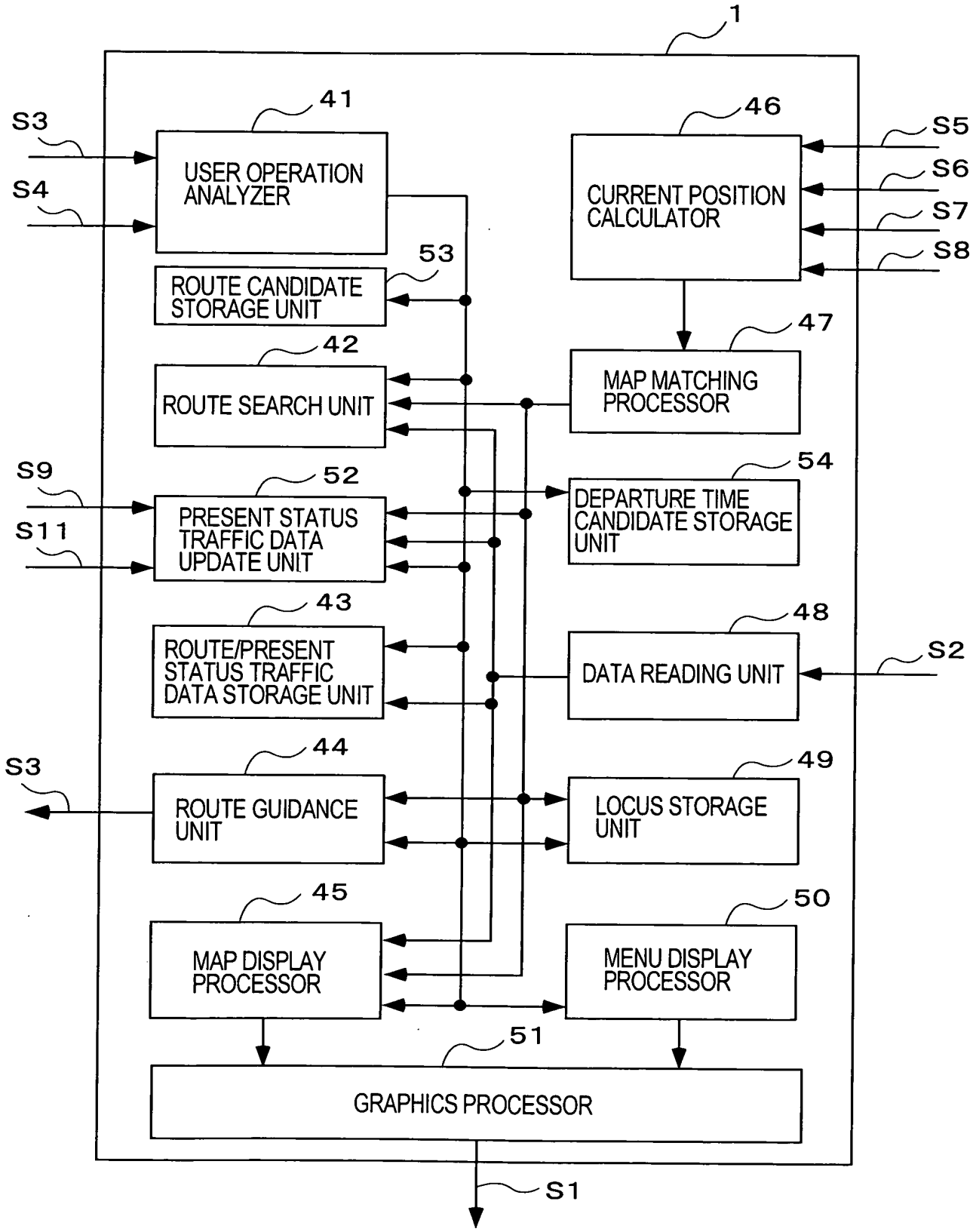

1
41
S3
S4
USER OPERATION ANALYZER
46
S5
S6
S7
S8
CURRENT POSITION CALCULATOR
53
ROUTE CANDIDATE STORAGE UNIT
47
42
ROUTE SEARCH UNIT
MAP MATCHING PROCESSOR
54
S9
52
S11
PRESENT STATUS TRAFFIC DATA UPDATE UNIT
DEPARTURE TIME CANDIDATE STORAGE UNIT
43
48
S2
ROUTE/PRESENT STATUS TRAFFIC DATA STORAGE UNIT
DATA READING UNIT
S3
44
49
ROUTE GUIDANCE UNIT
LOCUS STORAGE UNIT
45
50
MAP DISPLAY PROCESSOR
MENU DISPLAY PROCESSOR
51
GRAPHICS PROCESSOR
S1

FIG.8

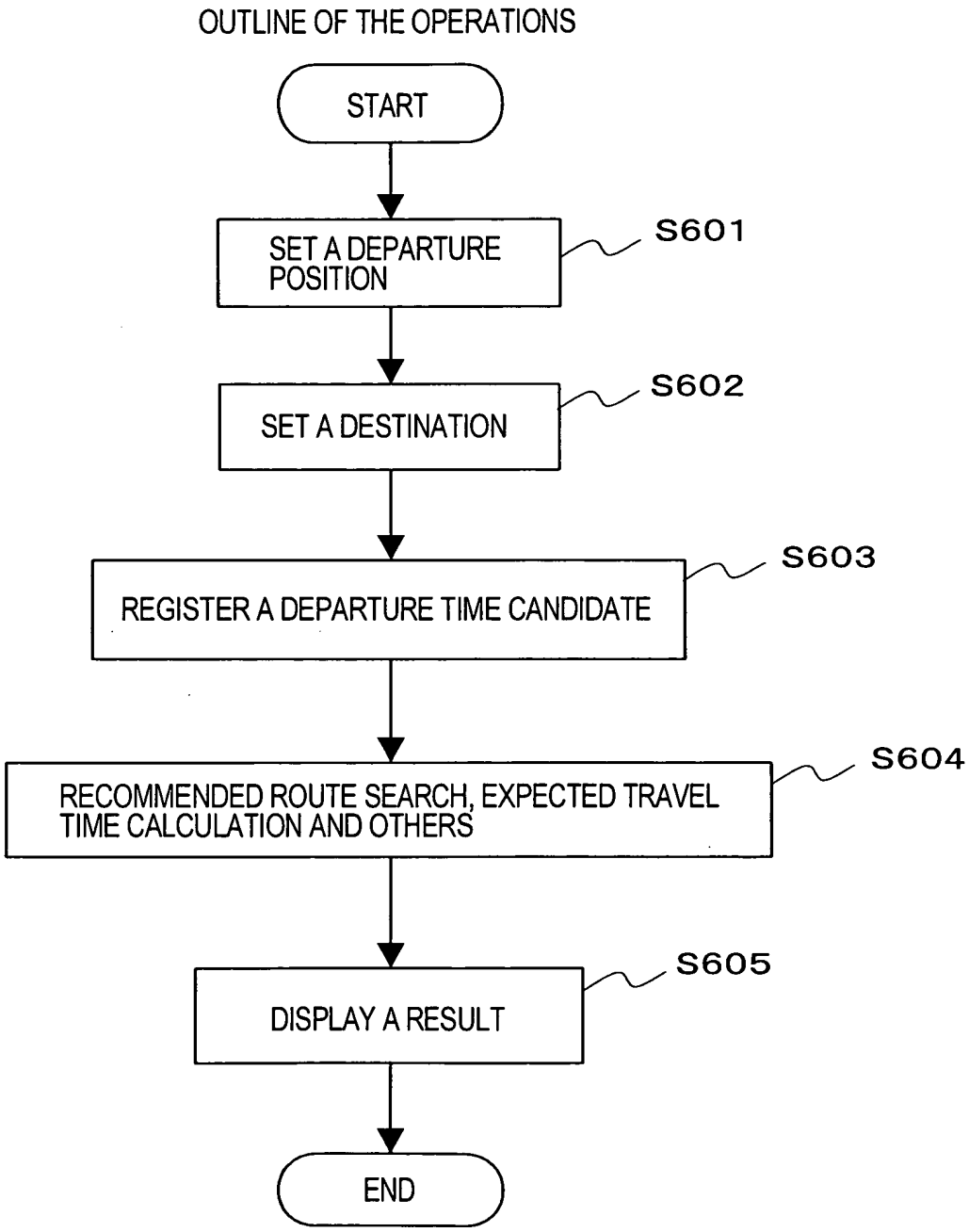

OUTLINE OF THE OPERATIONS
START
SET A DEPARTURE POSITION
S601
SET A DESTINATION
S602
REGISTER A DEPARTURE TIME CANDIDATE
S603
RECOMMENDED ROUTE SEARCH, EXPECTED TRAVEL TIME CALCULATION AND OTHERS
S604
DISPLAY A RESULT
S605
END

FIG.9

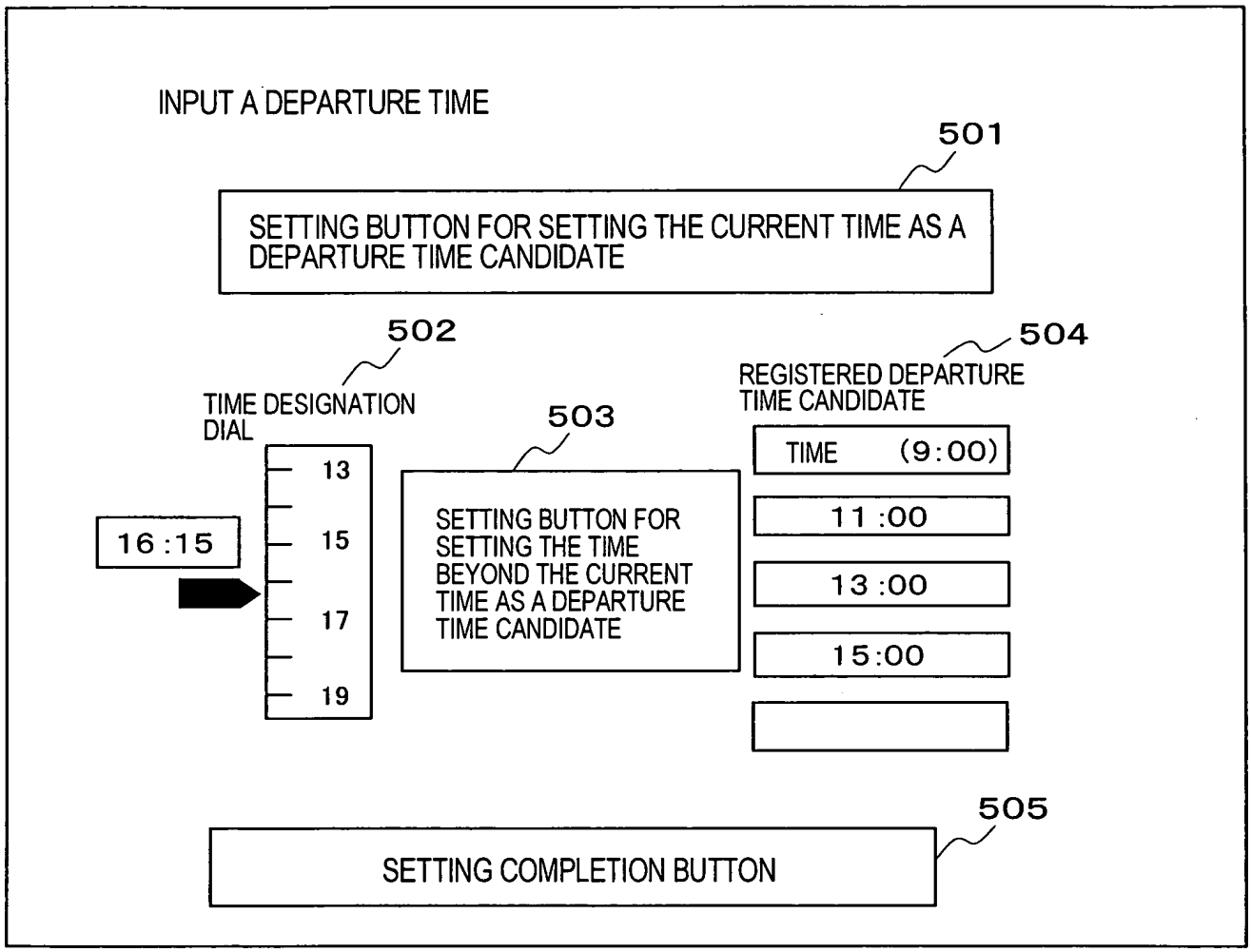

INPUT A DEPARTURE TIME
501
SETTING BUTTON FOR SETTING THE CURRENT TIME AS A DEPARTURE TIME CANDIDATE
502
TIME DESIGNATION DIAL
503
504
REGISTERED DEPARTURE TIME CANDIDATE
16:15
13
15
17
19
SETTING BUTTON FOR SETTING THE TIME BEYOND THE CURRENT TIME AS A DEPARTURE TIME CANDIDATE
TIME (9:00)
11:00
13:00
15:00
505
SETTING COMPLETION BUTTON

FIG.10

DEPARTURE TIME CANDIDATE REGISTRATION PROCESSING

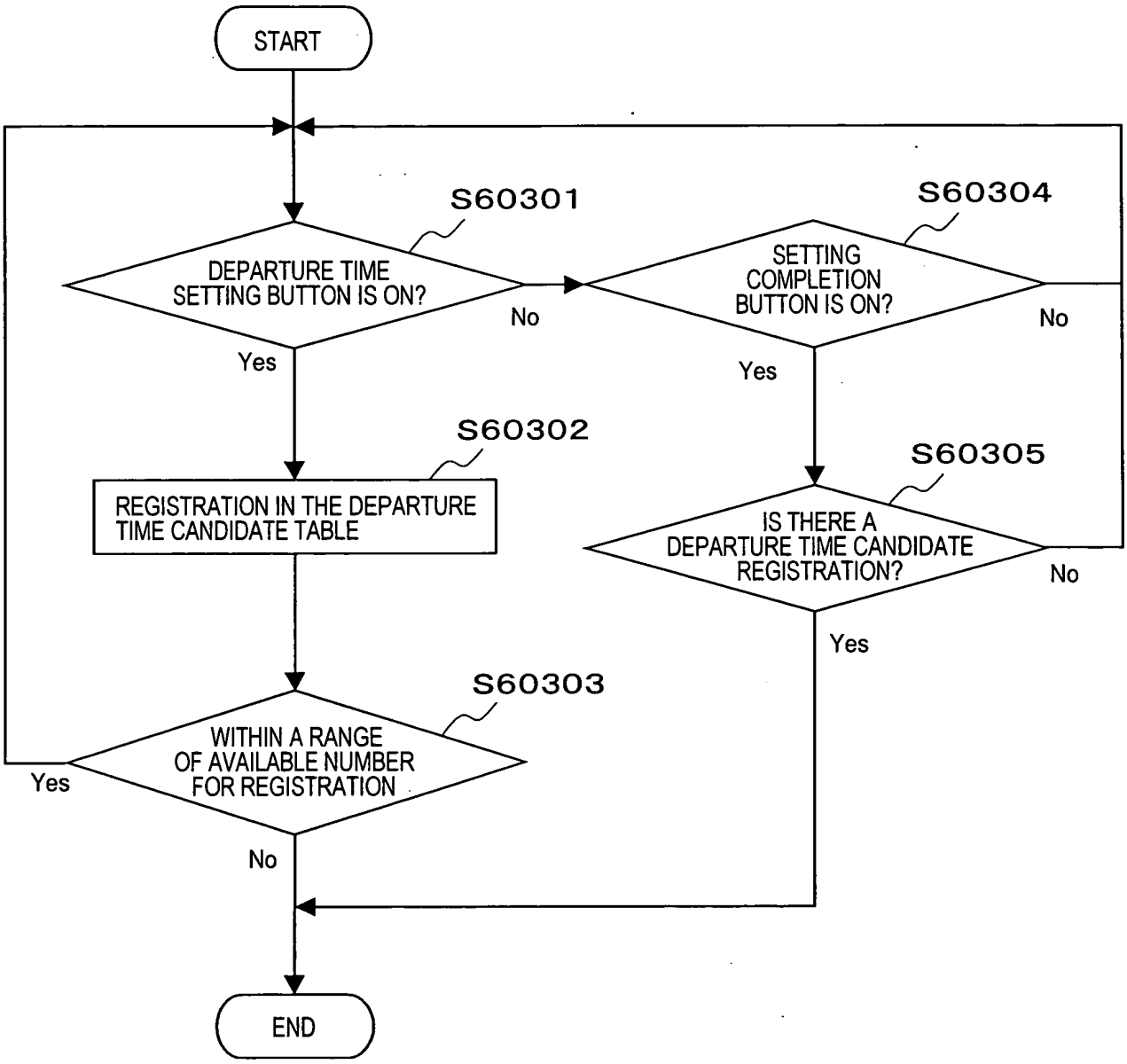


FIG.11

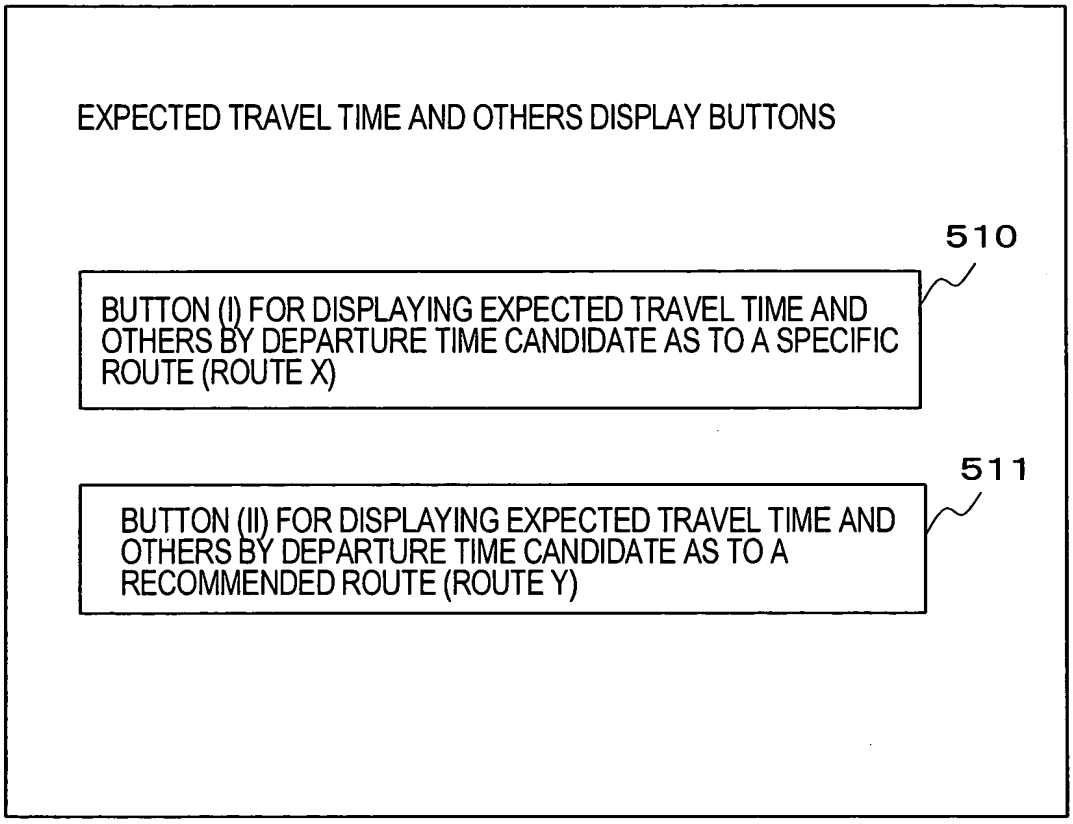

EXPECTED TRAVEL TIME AND OTHERS DISPLAY BUTTONS
510
BUTTON (I) FOR DISPLAYING EXPECTED TRAVEL TIME AND OTHERS BY DEPARTURE TIME CANDIDATE AS TO A SPECIFIC ROUTE (ROUTE X)
511
BUTTON (II) FOR DISPLAYING EXPECTED TRAVEL TIME AND OTHERS BY DEPARTURE TIME CANDIDATE AS TO A RECOMMENDED ROUTE (ROUTE Y)

FIG.12

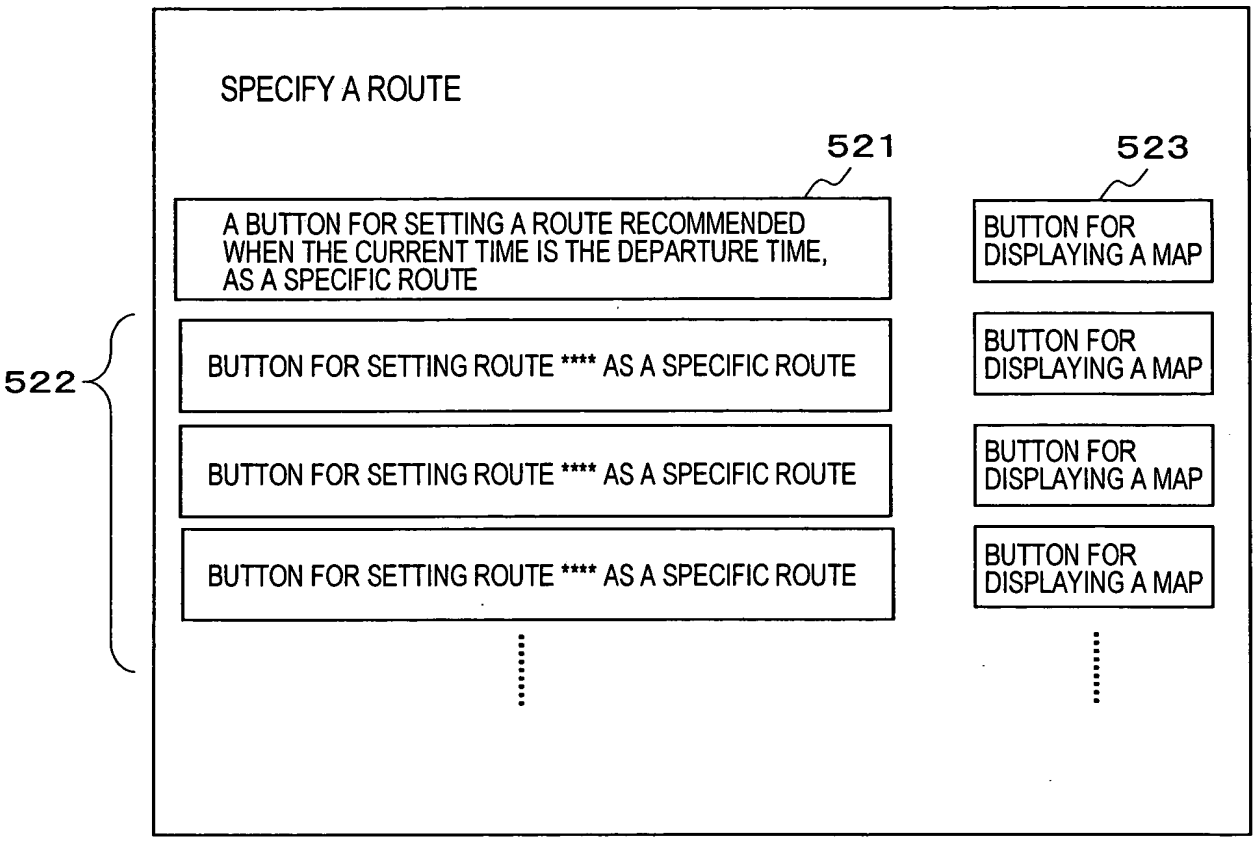

SPECIFY A ROUTE
521
523
A BUTTON FOR SETTING A ROUTE RECOMMENDED WHEN THE CURRENT TIME IS THE DEPARTURE TIME, AS A SPECIFIC ROUTE
BUTTON FOR DISPLAYING A MAP
522
BUTTON FOR SETTING ROUTE **** AS A SPECIFIC ROUTE
BUTTON FOR DISPLAYING A MAP
BUTTON FOR SETTING ROUTE **** AS A SPECIFIC ROUTE
BUTTON FOR DISPLAYING A MAP
BUTTON FOR SETTING ROUTE **** AS A SPECIFIC ROUTE
BUTTON FOR DISPLAYING A MAP

FIG.13

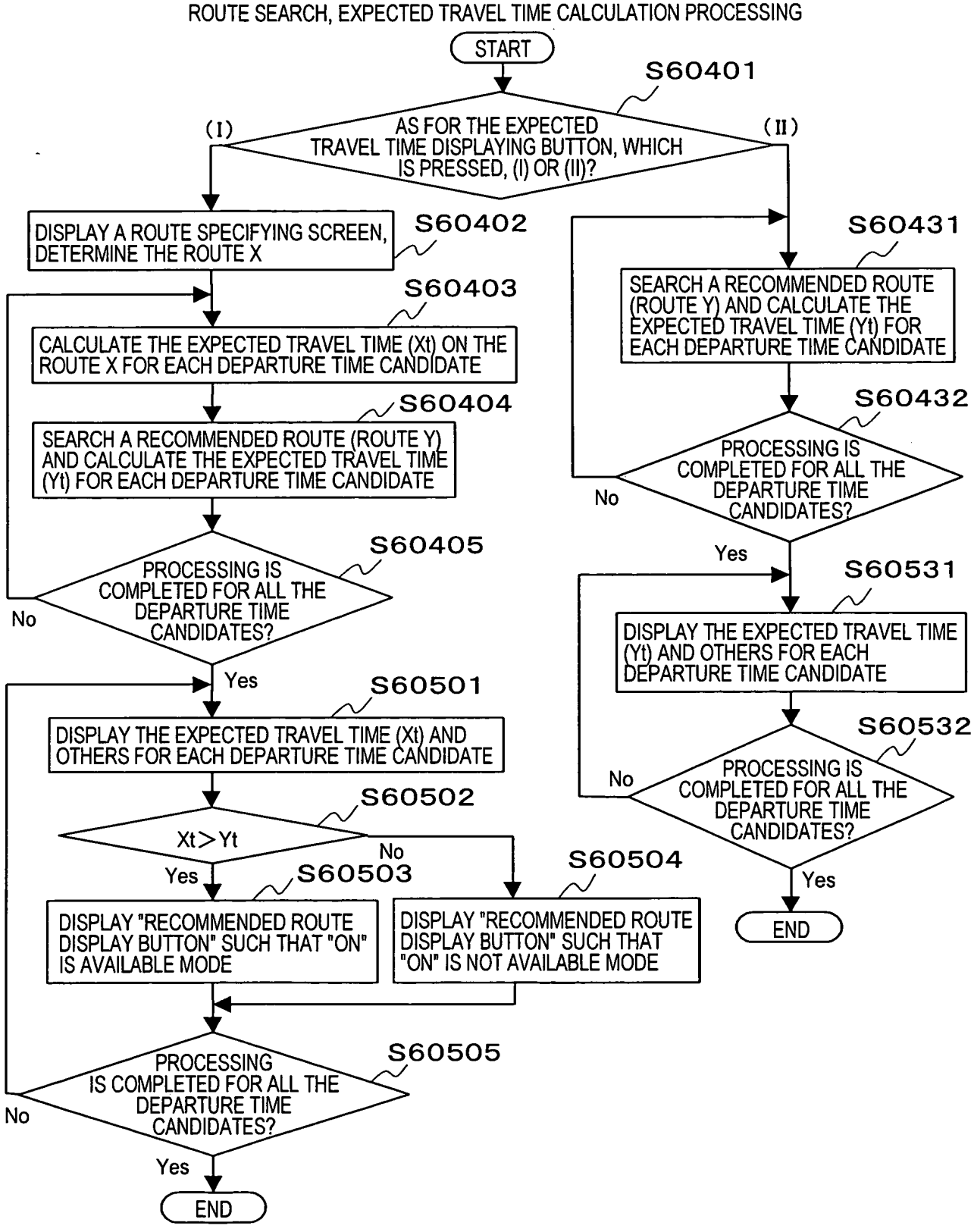

ROUTE SEARCH, EXPECTED TRAVEL TIME CALCULATION PROCESSING
START
S60401
AS FOR THE EXPECTED TRAVEL TIME DISPLAYING BUTTON, WHICH IS PRESSED, (I) OR (II)?
(I)
(II)
DISPLAY A ROUTE SPECIFYING SCREEN, DETERMINE THE ROUTE X
S60402
S60403
CALCULATE THE EXPECTED TRAVEL TIME (Xt) ON THE ROUTE X FOR EACH DEPARTURE TIME CANDIDATE
S60404
SEARCH A RECOMMENDED ROUTE (ROUTE Y) AND CALCULATE THE EXPECTED TRAVEL TIME (Yt) FOR EACH DEPARTURE TIME CANDIDATE
S60405
PROCESSING IS COMPLETED FOR ALL THE DEPARTURE TIME CANDIDATES?
No
Yes
S60501
DISPLAY THE EXPECTED TRAVEL TIME (Xt) AND OTHERS FOR EACH DEPARTURE TIME CANDIDATE
S60502
Xt>Yt
Yes
No
S60503
DISPLAY "RECOMMENDED ROUTE DISPLAY BUTTON" SUCH THAT "ON" IS AVAILABLE MODE
S60504
DISPLAY "RECOMMENDED ROUTE DISPLAY BUTTON" SUCH THAT "ON" IS NOT AVAILABLE MODE
S60505
PROCESSING IS COMPLETED FOR ALL THE DEPARTURE TIME CANDIDATES?
No
Yes
END
S60431
SEARCH A RECOMMENDED ROUTE (ROUTE Y) AND CALCULATE THE EXPECTED TRAVEL TIME (Yt) FOR EACH DEPARTURE TIME CANDIDATE
S60432
PROCESSING IS COMPLETED FOR ALL THE DEPARTURE TIME CANDIDATES?
No
Yes
S60531
DISPLAY THE EXPECTED TRAVEL TIME (Yt) AND OTHERS FOR EACH DEPARTURE TIME CANDIDATE
S60532
PROCESSING IS COMPLETED FOR ALL THE DEPARTURE TIME CANDIDATES?
No
Yes
END

FIG.14

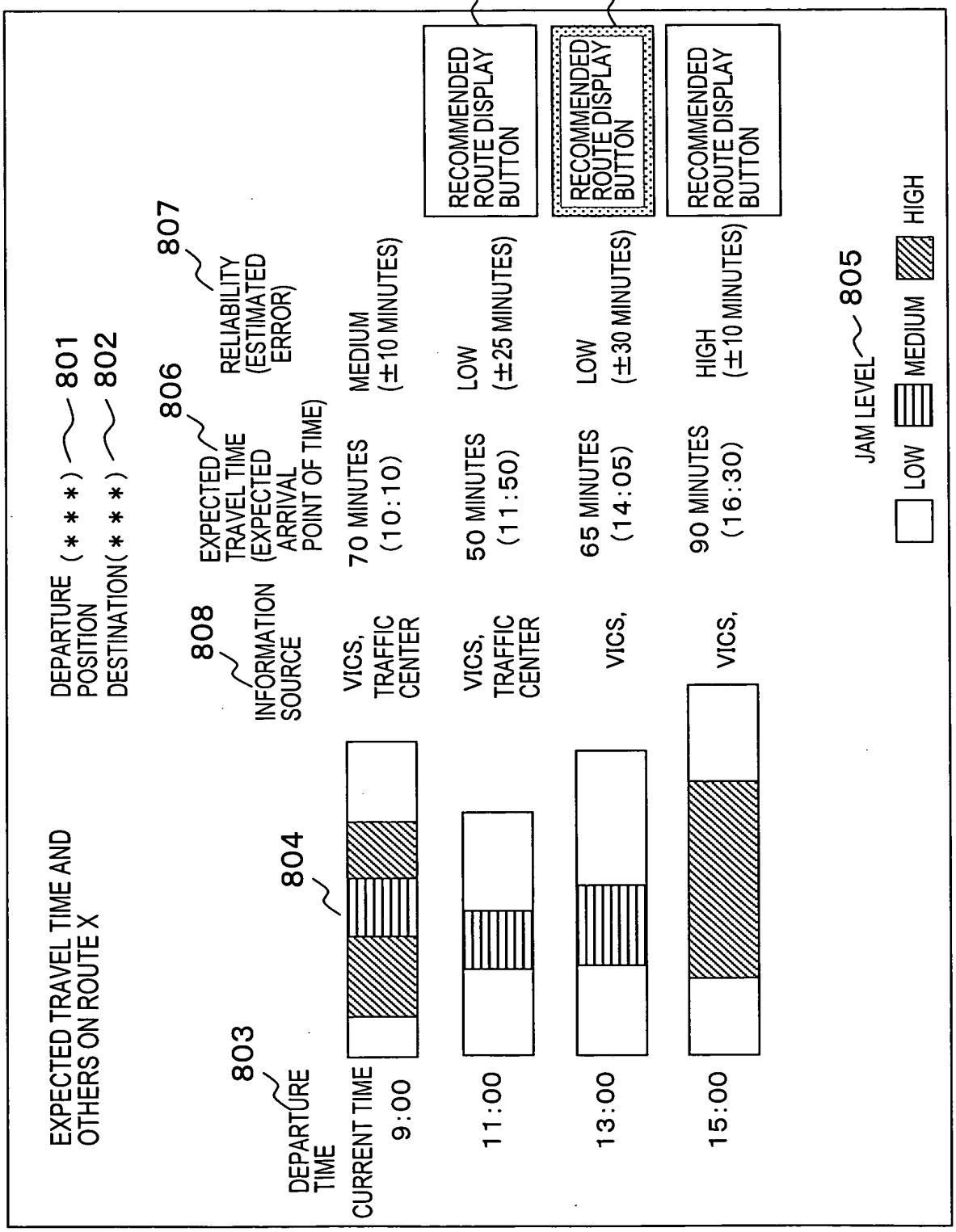

EXPECTED TRAVEL TIME AND OTHERS ON ROUTE X
DEPARTURE POSITION (***) 801
DESTINATION(***) 802
803
DEPARTURE TIME
804
806
EXPECTED TRAVEL TIME (EXPECTED ARRIVAL POINT OF TIME)
807
RELIABILITY (ESTIMATED ERROR)
808
INFORMATION SOURCE
CURRENT TIME 9:00
VICS, TRAFFIC CENTER
70 MINUTES (10:10)
MEDIUM (±10 MINUTES)
11:00
VICS, TRAFFIC CENTER
50 MINUTES (11:50)
LOW (±25 MINUTES)
13:00
VICS,
65 MINUTES (14:05)
LOW (±30 MINUTES)
15:00
VICS,
90 MINUTES (16:30)
HIGH (±10 MINUTES)
RECOMMENDED ROUTE DISPLAY BUTTON
810
RECOMMENDED ROUTE DISPLAY BUTTON
811
RECOMMENDED ROUTE DISPLAY BUTTON
JAM LEVEL 805
LOW
MEDIUM
HIGH

FIG.15

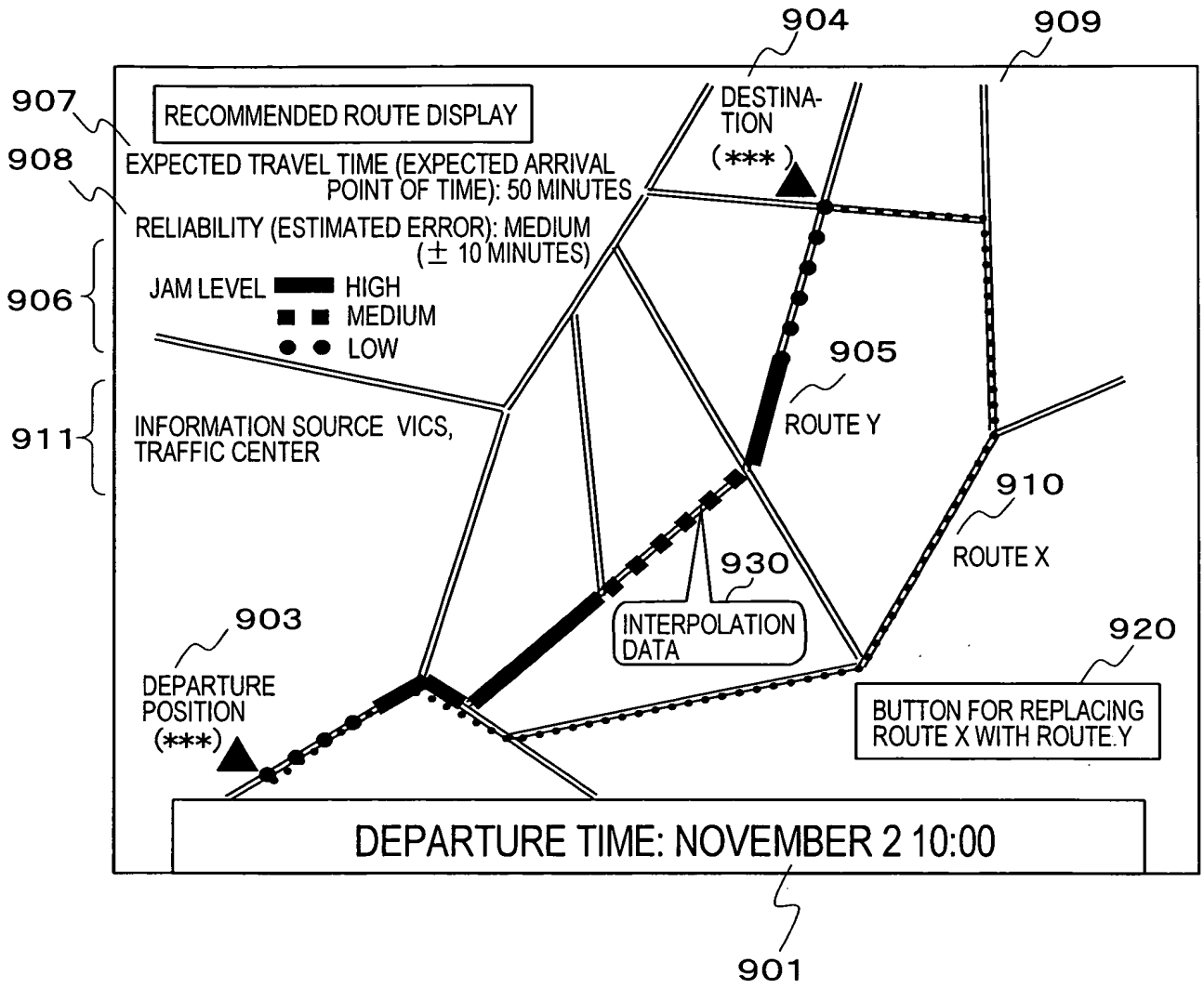

904
909
907
RECOMMENDED ROUTE DISPLAY
DESTINA-
TION
(***)
908
EXPECTED TRAVEL TIME (EXPECTED ARRIVAL POINT OF TIME): 50 MINUTES
RELIABILITY (ESTIMATED ERROR): MEDIUM (± 10 MINUTES)
906
JAM LEVEL HIGH
MEDIUM
LOW
905
ROUTE Y
911
INFORMATION SOURCE VICS, TRAFFIC CENTER
910
ROUTE X
930
INTERPOLATION DATA
903
920
DEPARTURE POSITION
(***)
BUTTON FOR REPLACING ROUTE X WITH ROUTE Y
DEPARTURE TIME: NOVEMBER 2 10:00
901

FIG.16

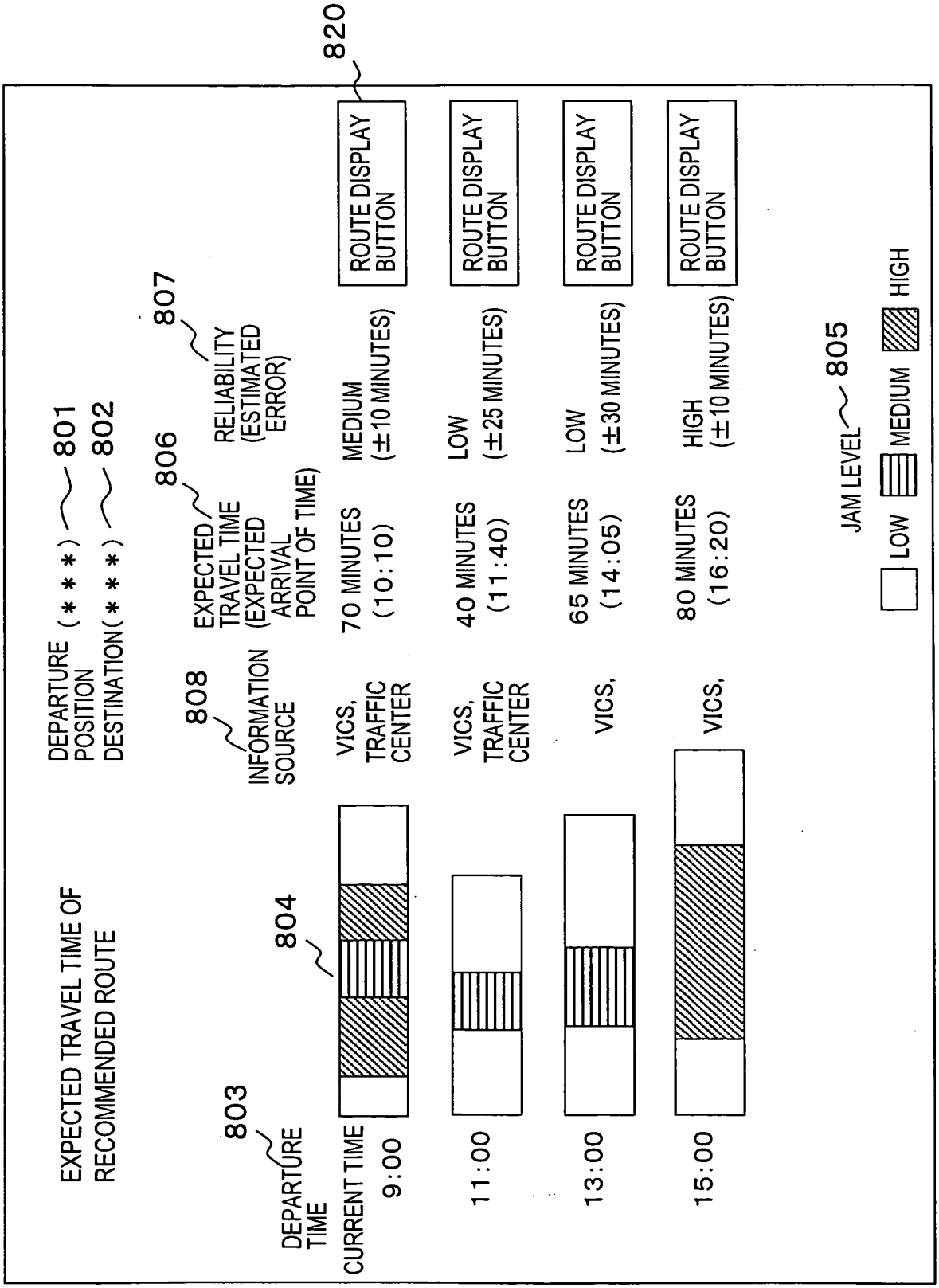

EXPECTED TRAVEL TIME OF RECOMMENDED ROUTE
DEPARTURE POSITION (* * *) 801
DESTINATION (* * *) 802
803
DEPARTURE TIME
804
806
EXPECTED TRAVEL TIME (EXPECTED ARRIVAL POINT OF TIME)
807
RELIABILITY (ESTIMATED ERROR)
808
INFORMATION SOURCE
820
ROUTE DISPLAY BUTTON
CURRENT TIME 9:00
VICS, TRAFFIC CENTER
70 MINUTES (10:10)
MEDIUM (±10 MINUTES)
11:00
VICS, TRAFFIC CENTER
40 MINUTES (11:40)
LOW (±25 MINUTES)
13:00
VICS,
65 MINUTES (14:05)
LOW (±30 MINUTES)
15:00
VICS,
80 MINUTES (16:20)
HIGH (±10 MINUTES)
JAM LEVEL 805
LOW
MEDIUM
HIGH

FIG.17

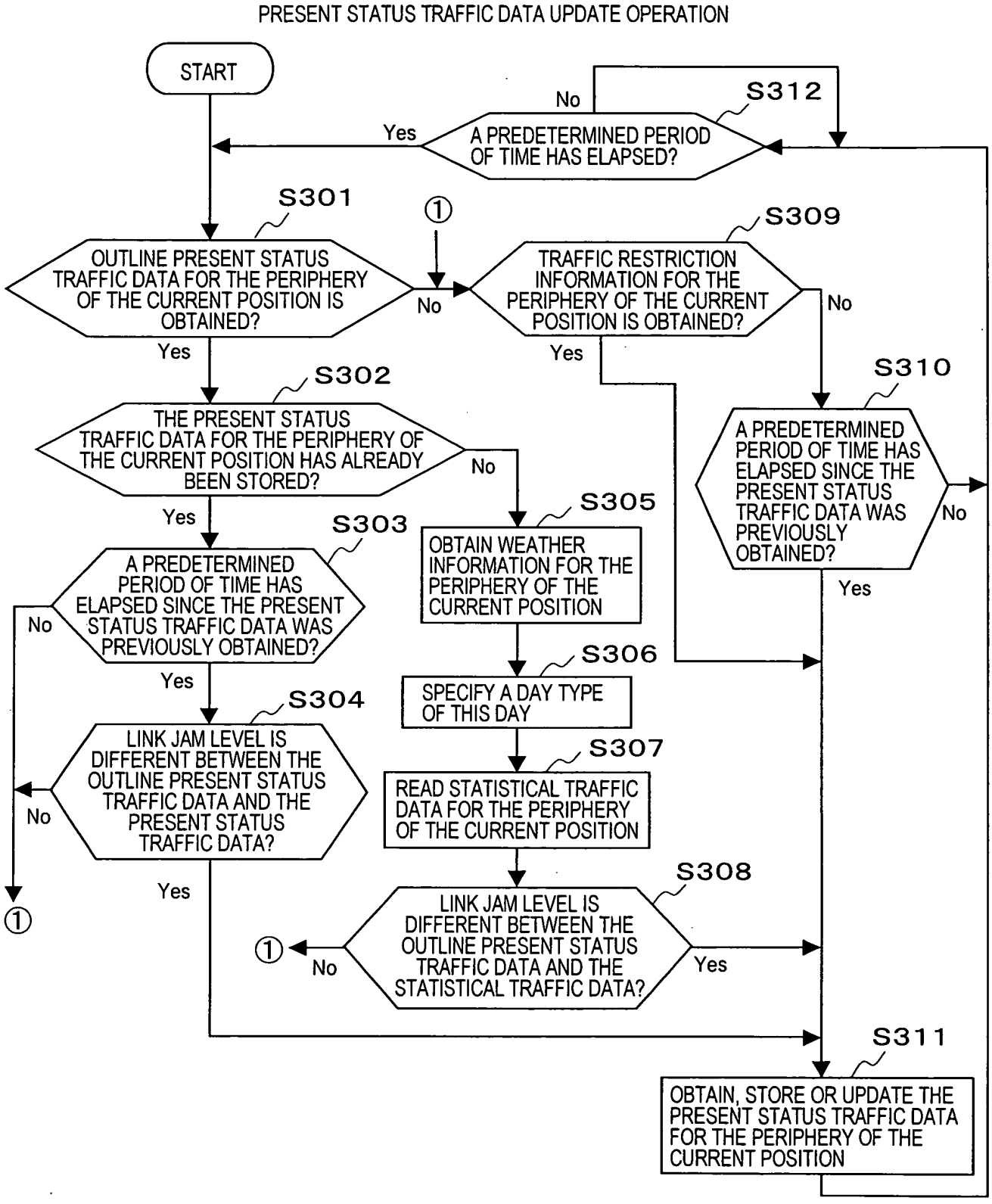

PRESENT STATUS TRAFFIC DATA UPDATE OPERATION
START
S312
No
Yes
A PREDETERMINED PERIOD OF TIME HAS ELAPSED?
S301
①
S309
OUTLINE PRESENT STATUS TRAFFIC DATA FOR THE PERIPHERY OF THE CURRENT POSITION IS OBTAINED?
No
TRAFFIC RESTRICTION INFORMATION FOR THE PERIPHERY OF THE CURRENT POSITION IS OBTAINED?
No
Yes
Yes
S302
S310
THE PRESENT STATUS TRAFFIC DATA FOR THE PERIPHERY OF THE CURRENT POSITION HAS ALREADY BEEN STORED?
No
A PREDETERMINED PERIOD OF TIME HAS ELAPSED SINCE THE PRESENT STATUS TRAFFIC DATA WAS PREVIOUSLY OBTAINED?
No
Yes
S305
S303
Yes
OBTAIN WEATHER INFORMATION FOR THE PERIPHERY OF THE CURRENT POSITION
A PREDETERMINED PERIOD OF TIME HAS ELAPSED SINCE THE PRESENT STATUS TRAFFIC DATA WAS PREVIOUSLY OBTAINED?
No
Yes
S306
SPECIFY A DAY TYPE OF THIS DAY
S304
S307
LINK JAM LEVEL IS DIFFERENT BETWEEN THE OUTLINE PRESENT STATUS TRAFFIC DATA AND THE PRESENT STATUS TRAFFIC DATA?
No
READ STATISTICAL TRAFFIC DATA FOR THE PERIPHERY OF THE CURRENT POSITION
Yes
①
S308
①
LINK JAM LEVEL IS DIFFERENT BETWEEN THE OUTLINE PRESENT STATUS TRAFFIC DATA AND THE STATISTICAL TRAFFIC DATA?
No
Yes
S311
OBTAIN, STORE OR UPDATE THE PRESENT STATUS TRAFFIC DATA FOR THE PERIPHERY OF THE CURRENT POSITION

FIG.18

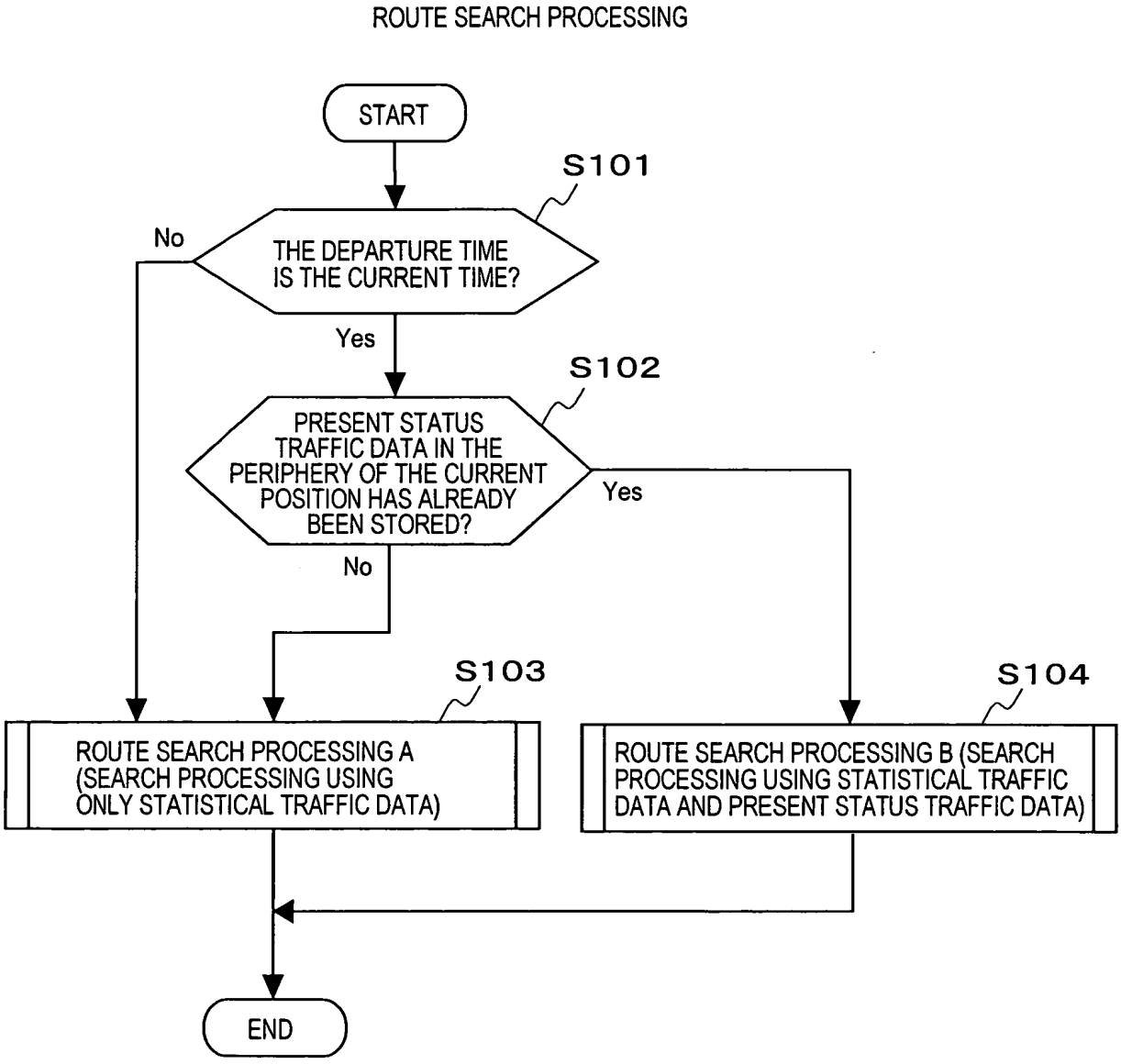

ROUTE SEARCH PROCESSING
START
S101
THE DEPARTURE TIME IS THE CURRENT TIME?
No
Yes
S102
PRESENT STATUS TRAFFIC DATA IN THE PERIPHERY OF THE CURRENT POSITION HAS ALREADY BEEN STORED?
Yes
No
S103
ROUTE SEARCH PROCESSING A (SEARCH PROCESSING USING ONLY STATISTICAL TRAFFIC DATA)
S104
ROUTE SEARCH PROCESSING B (SEARCH PROCESSING USING STATISTICAL TRAFFIC DATA AND PRESENT STATUS TRAFFIC DATA)
END

FIG.19

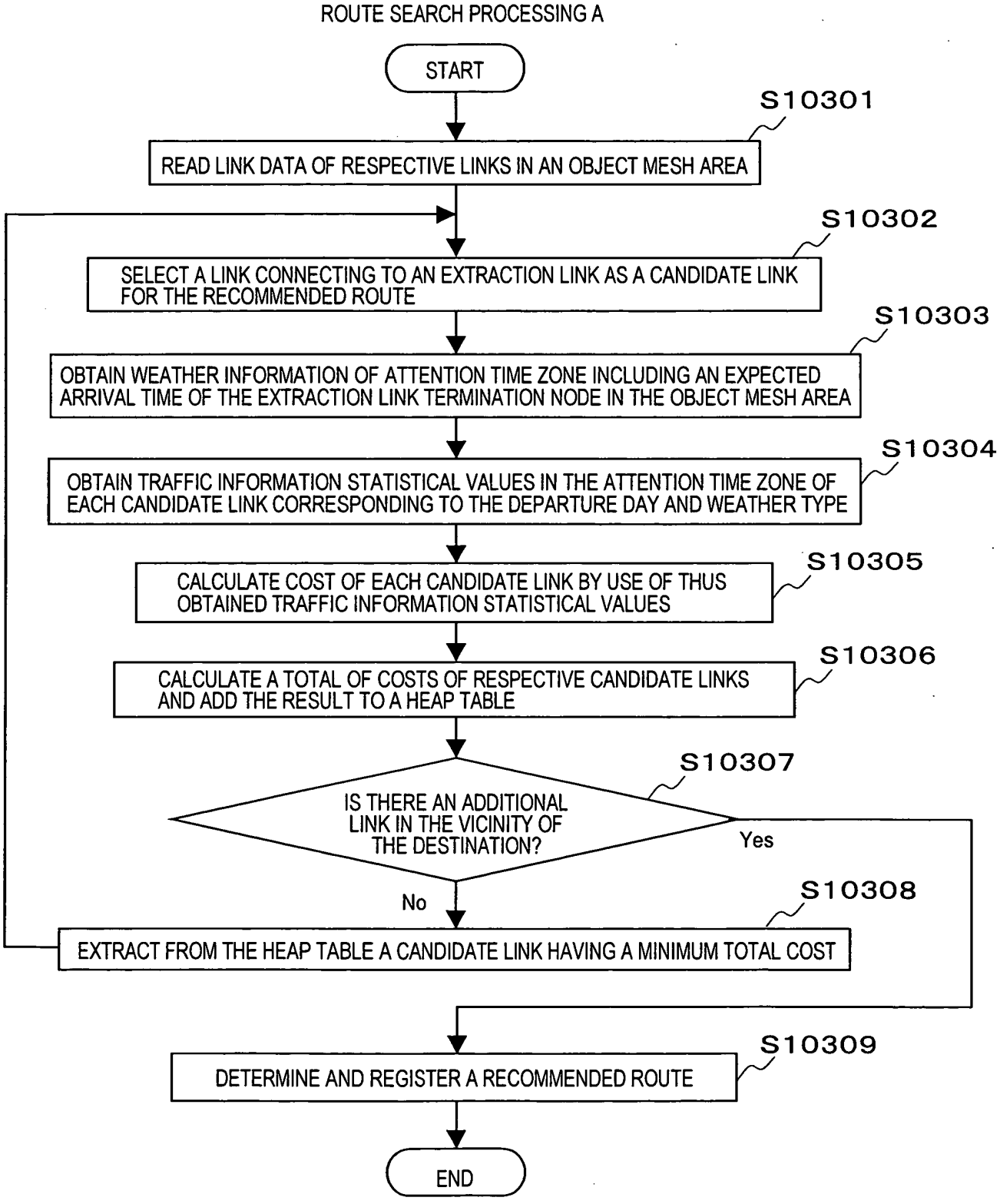

ROUTE SEARCH PROCESSING A
START
S10301
READ LINK DATA OF RESPECTIVE LINKS IN AN OBJECT MESH AREA
S10302
SELECT A LINK CONNECTING TO AN EXTRACTION LINK AS A CANDIDATE LINK FOR THE RECOMMENDED ROUTE
S10303
OBTAIN WEATHER INFORMATION OF ATTENTION TIME ZONE INCLUDING AN EXPECTED ARRIVAL TIME OF THE EXTRACTION LINK TERMINATION NODE IN THE OBJECT MESH AREA
S10304
OBTAIN TRAFFIC INFORMATION STATISTICAL VALUES IN THE ATTENTION TIME ZONE OF EACH CANDIDATE LINK CORRESPONDING TO THE DEPARTURE DAY AND WEATHER TYPE
S10305
CALCULATE COST OF EACH CANDIDATE LINK BY USE OF THUS OBTAINED TRAFFIC INFORMATION STATISTICAL VALUES
S10306
CALCULATE A TOTAL OF COSTS OF RESPECTIVE CANDIDATE LINKS AND ADD THE RESULT TO A HEAP TABLE
S10307
IS THERE AN ADDITIONAL LINK IN THE VICINITY OF THE DESTINATION?
Yes
No
S10308
EXTRACT FROM THE HEAP TABLE A CANDIDATE LINK HAVING A MINIMUM TOTAL COST
S10309
DETERMINE AND REGISTER A RECOMMENDED ROUTE
END

FIG.20

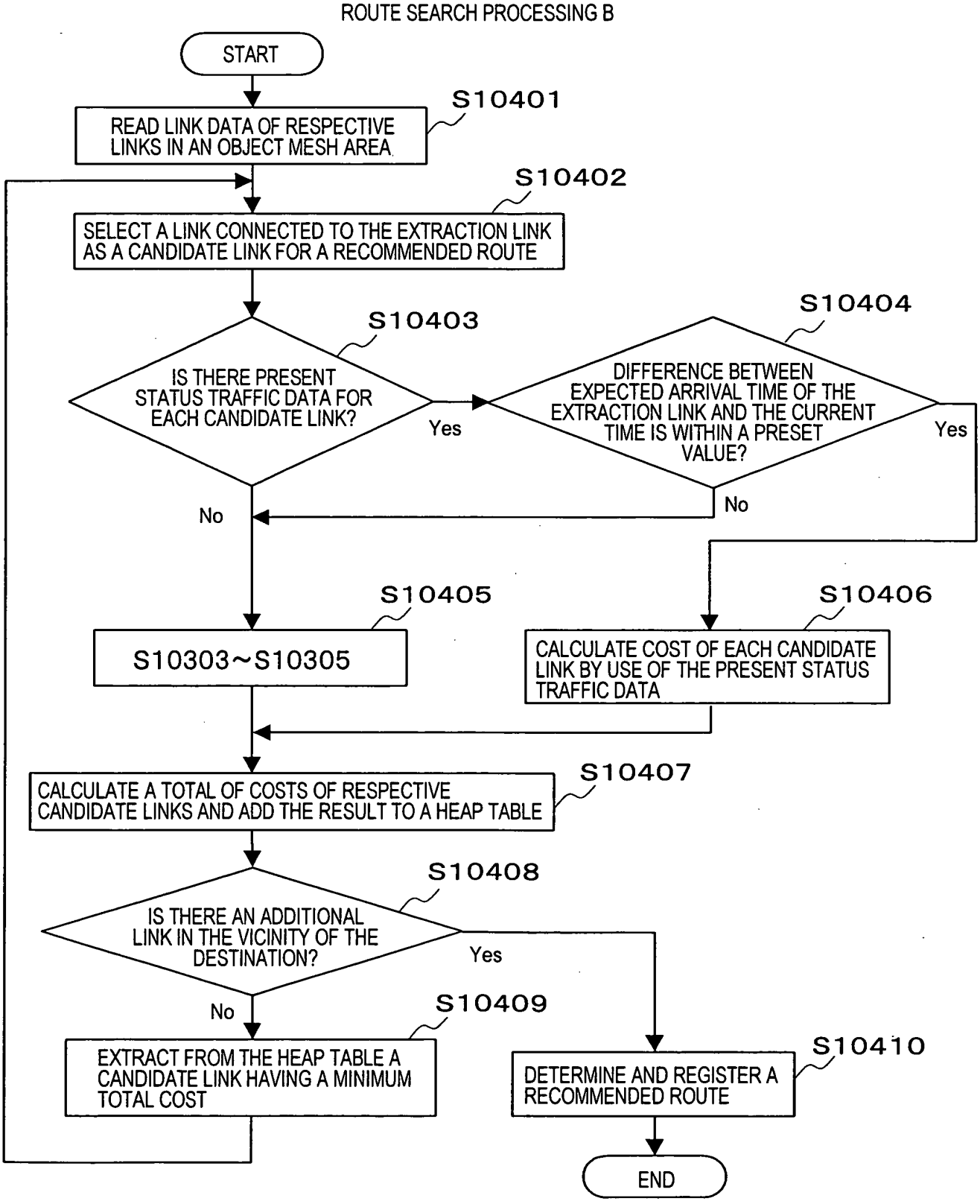

ROUTE SEARCH PROCESSING B
START
S10401
READ LINK DATA OF RESPECTIVE LINKS IN AN OBJECT MESH AREA
S10402
SELECT A LINK CONNECTED TO THE EXTRACTION LINK AS A CANDIDATE LINK FOR A RECOMMENDED ROUTE
S10403
IS THERE PRESENT STATUS TRAFFIC DATA FOR EACH CANDIDATE LINK?
Yes
No
S10404
DIFFERENCE BETWEEN EXPECTED ARRIVAL TIME OF THE EXTRACTION LINK AND THE CURRENT TIME IS WITHIN A PRESET VALUE?
Yes
No
S10405
S10303~S10305
S10406
CALCULATE COST OF EACH CANDIDATE LINK BY USE OF THE PRESENT STATUS TRAFFIC DATA
S10407
CALCULATE A TOTAL OF COSTS OF RESPECTIVE CANDIDATE LINKS AND ADD THE RESULT TO A HEAP TABLE
S10408
IS THERE AN ADDITIONAL LINK IN THE VICINITY OF THE DESTINATION?
Yes
No
S10409
EXTRACT FROM THE HEAP TABLE A CANDIDATE LINK HAVING A MINIMUM TOTAL COST
S10410
DETERMINE AND REGISTER A RECOMMENDED ROUTE
END

FIG.21

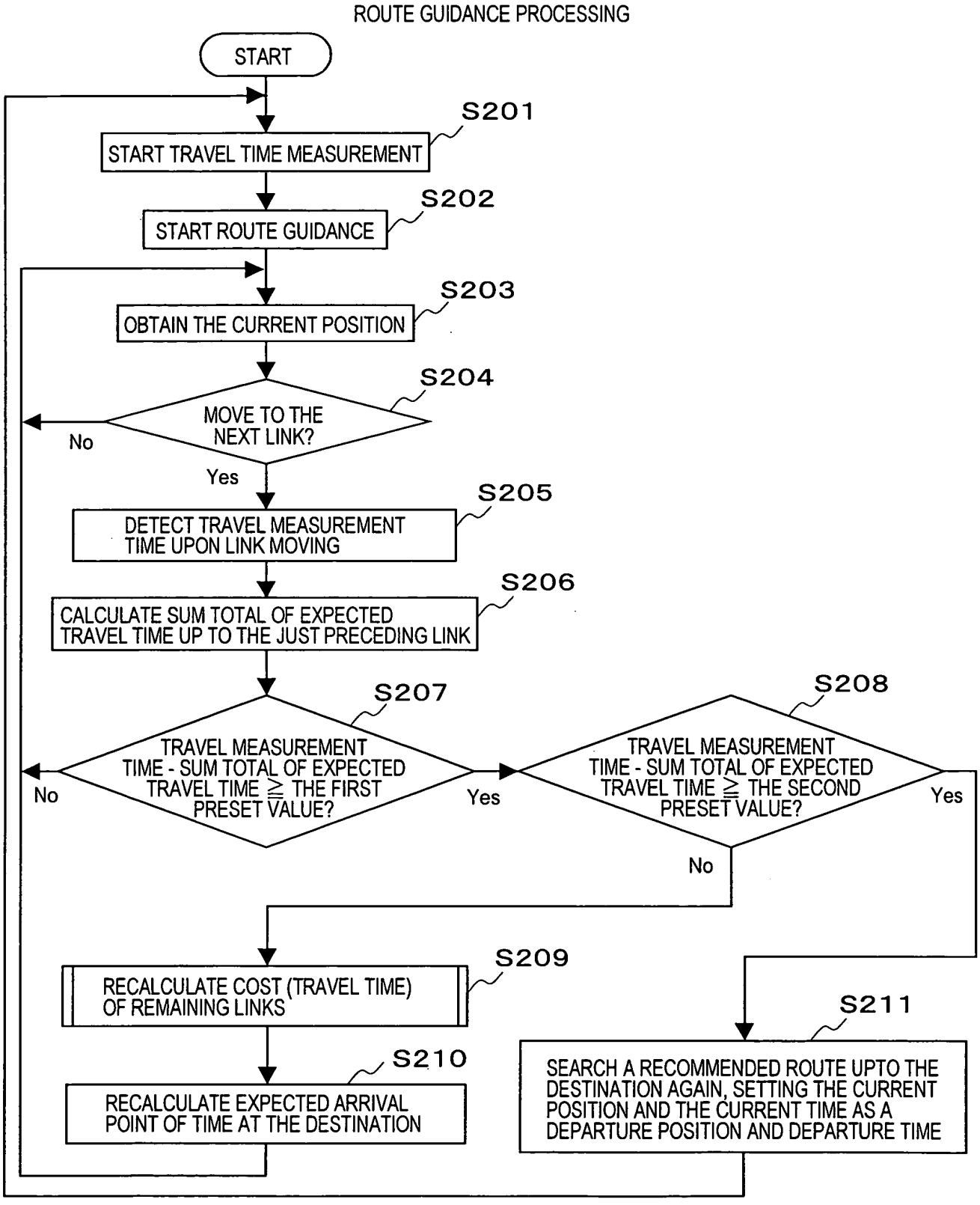

ROUTE GUIDANCE PROCESSING
START
S201
START TRAVEL TIME MEASUREMENT
S202
START ROUTE GUIDANCE
S203
OBTAIN THE CURRENT POSITION
S204
MOVE TO THE NEXT LINK?
No
Yes
S205
DETECT TRAVEL MEASUREMENT TIME UPON LINK MOVING
S206
CALCULATE SUM TOTAL OF EXPECTED TRAVEL TIME UP TO THE JUST PRECEDING LINK
S207
TRAVEL MEASUREMENT TIME - SUM TOTAL OF EXPECTED TRAVEL TIME ≧ THE FIRST PRESET VALUE?
No
Yes
S208
TRAVEL MEASUREMENT TIME - SUM TOTAL OF EXPECTED TRAVEL TIME ≧ THE SECOND PRESET VALUE?
Yes
No
S209
RECALCULATE COST (TRAVEL TIME) OF REMAINING LINKS
S210
RECALCULATE EXPECTED ARRIVAL POINT OF TIME AT THE DESTINATION
S211
SEARCH A RECOMMENDED ROUTE UPTO THE DESTINATION AGAIN, SETTING THE CURRENT POSITION AND THE CURRENT TIME AS A DEPARTURE POSITION AND DEPARTURE TIME

FIG.22

REMAINING LINK COST RECALCULATION PROCESSING

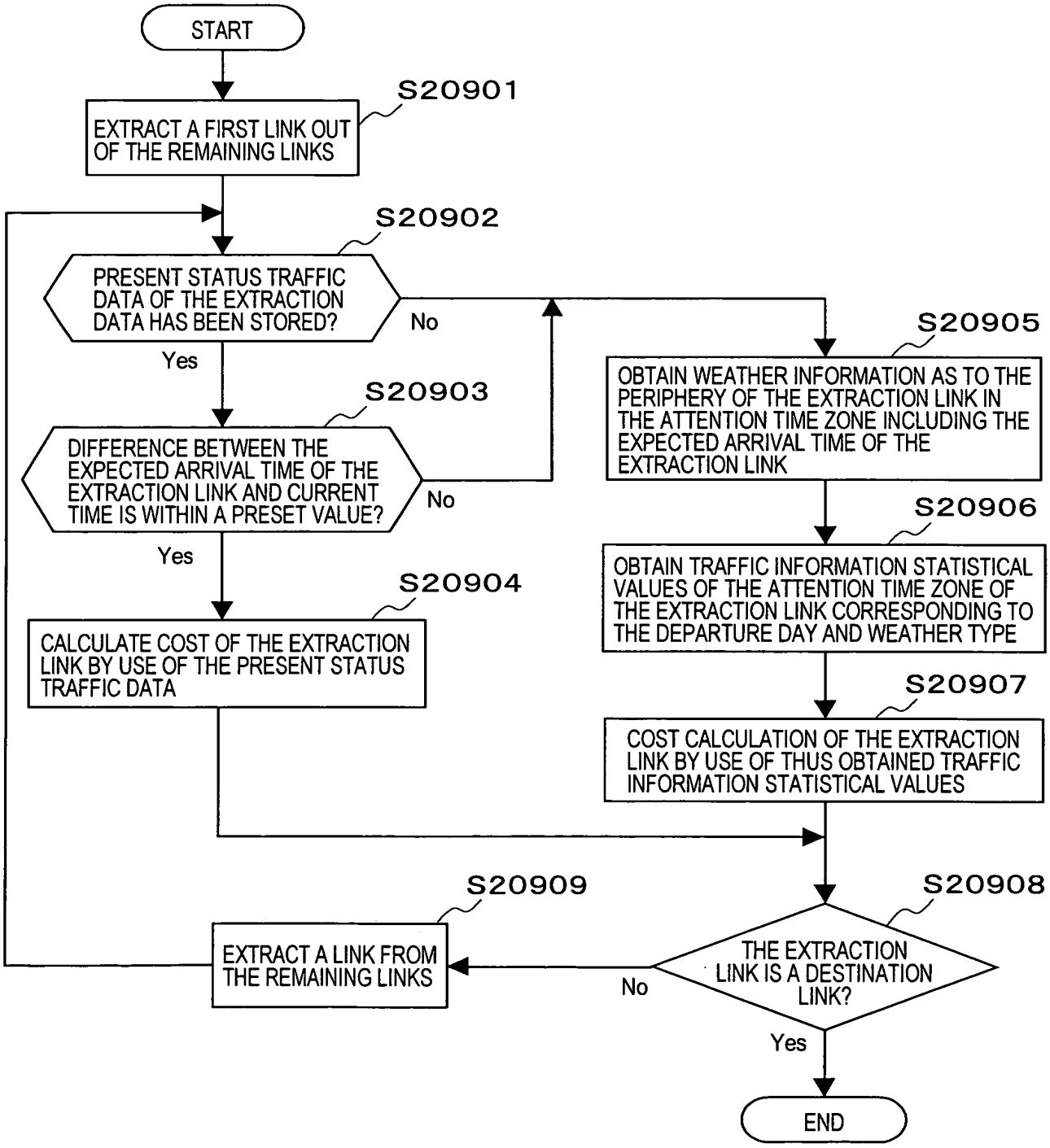


FIG.23

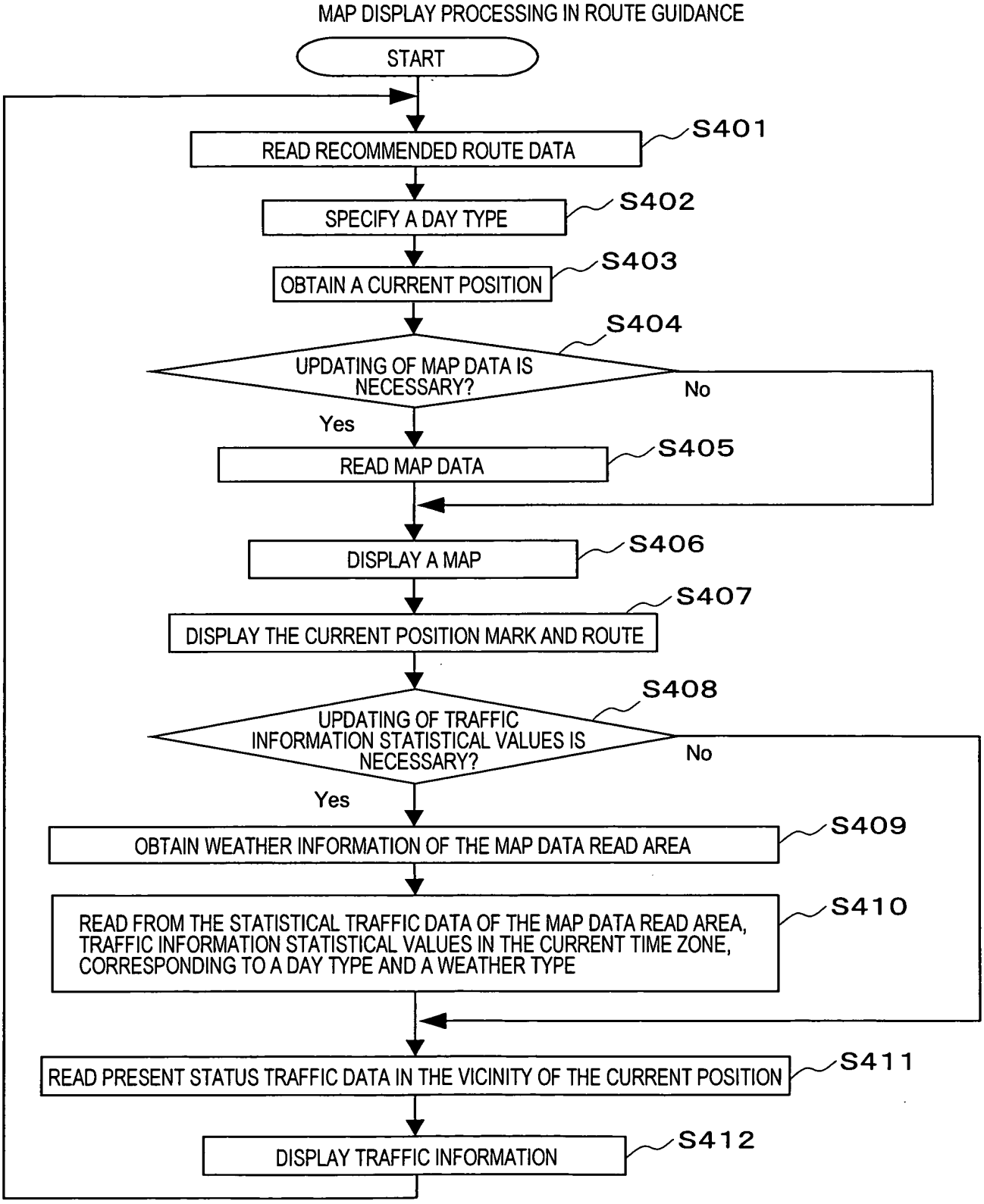

MAP DISPLAY PROCESSING IN ROUTE GUIDANCE
START
READ RECOMMENDED ROUTE DATA
S401
SPECIFY A DAY TYPE
S402
OBTAIN A CURRENT POSITION
S403
UPDATING OF MAP DATA IS NECESSARY?
S404
No
Yes
READ MAP DATA
S405
DISPLAY A MAP
S406
DISPLAY THE CURRENT POSITION MARK AND ROUTE
S407
UPDATING OF TRAFFIC INFORMATION STATISTICAL VALUES IS NECESSARY?
S408
No
Yes
OBTAIN WEATHER INFORMATION OF THE MAP DATA READ AREA
S409
READ FROM THE STATISTICAL TRAFFIC DATA OF THE MAP DATA READ AREA, TRAFFIC INFORMATION STATISTICAL VALUES IN THE CURRENT TIME ZONE, CORRESPONDING TO A DAY TYPE AND A WEATHER TYPE
S410
READ PRESENT STATUS TRAFFIC DATA IN THE VICINITY OF THE CURRENT POSITION
S411
DISPLAY TRAFFIC INFORMATION
S412

FIG.24

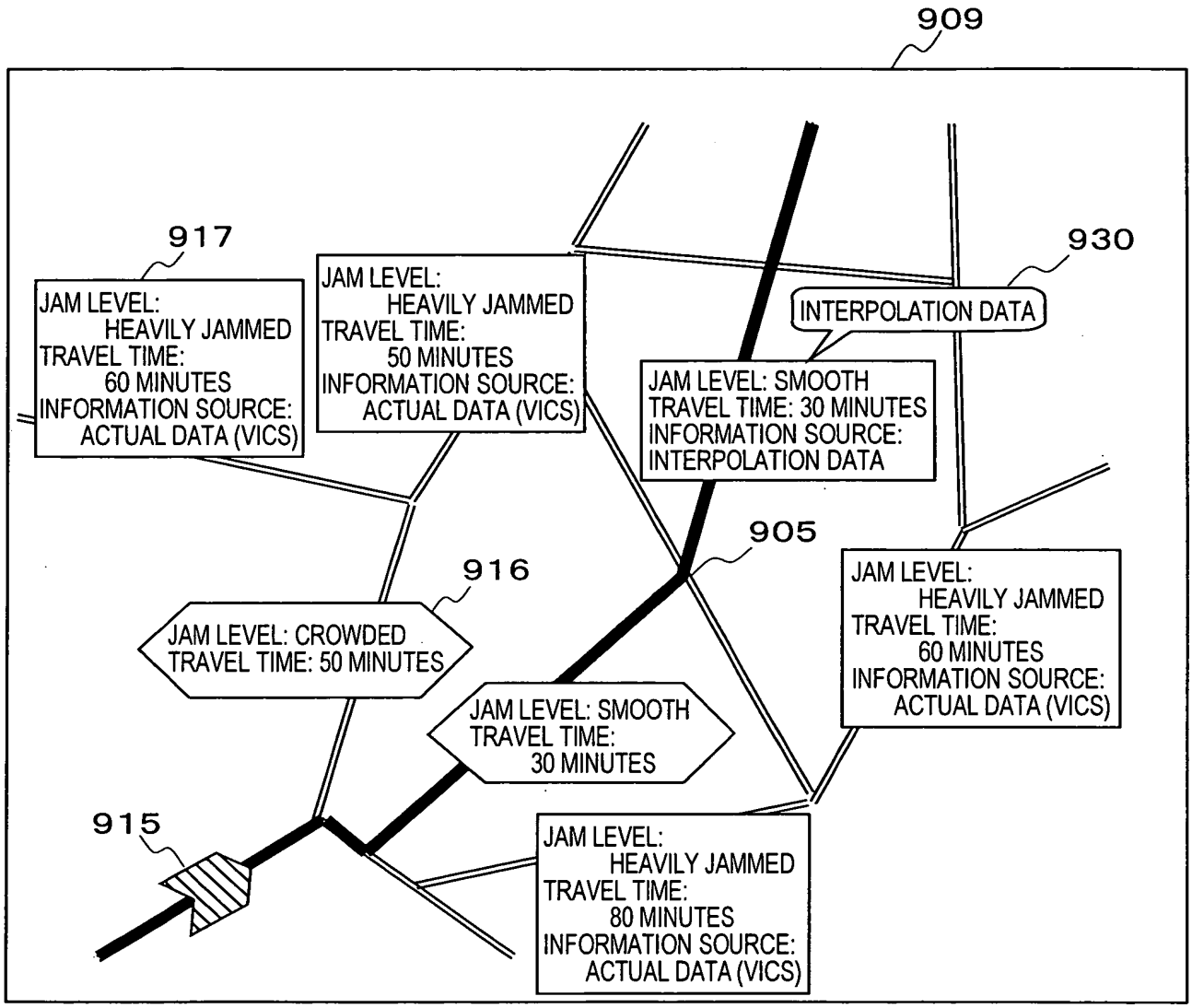

909
917
JAM LEVEL:
HEAVILY JAMMED
TRAVEL TIME:
60 MINUTES
INFORMATION SOURCE:
ACTUAL DATA (VICS)
JAM LEVEL:
HEAVILY JAMMED
TRAVEL TIME:
50 MINUTES
INFORMATION SOURCE:
ACTUAL DATA (VICS)
930
INTERPOLATION DATA
JAM LEVEL: SMOOTH
TRAVEL TIME: 30 MINUTES
INFORMATION SOURCE:
INTERPOLATION DATA
905
916
JAM LEVEL: CROWDED
TRAVEL TIME: 50 MINUTES
JAM LEVEL:
HEAVILY JAMMED
TRAVEL TIME:
60 MINUTES
INFORMATION SOURCE:
ACTUAL DATA (VICS)
JAM LEVEL: SMOOTH
TRAVEL TIME:
30 MINUTES
915
JAM LEVEL:
HEAVILY JAMMED
TRAVEL TIME:
80 MINUTES
INFORMATION SOURCE:
ACTUAL DATA (VICS)

FIG.25

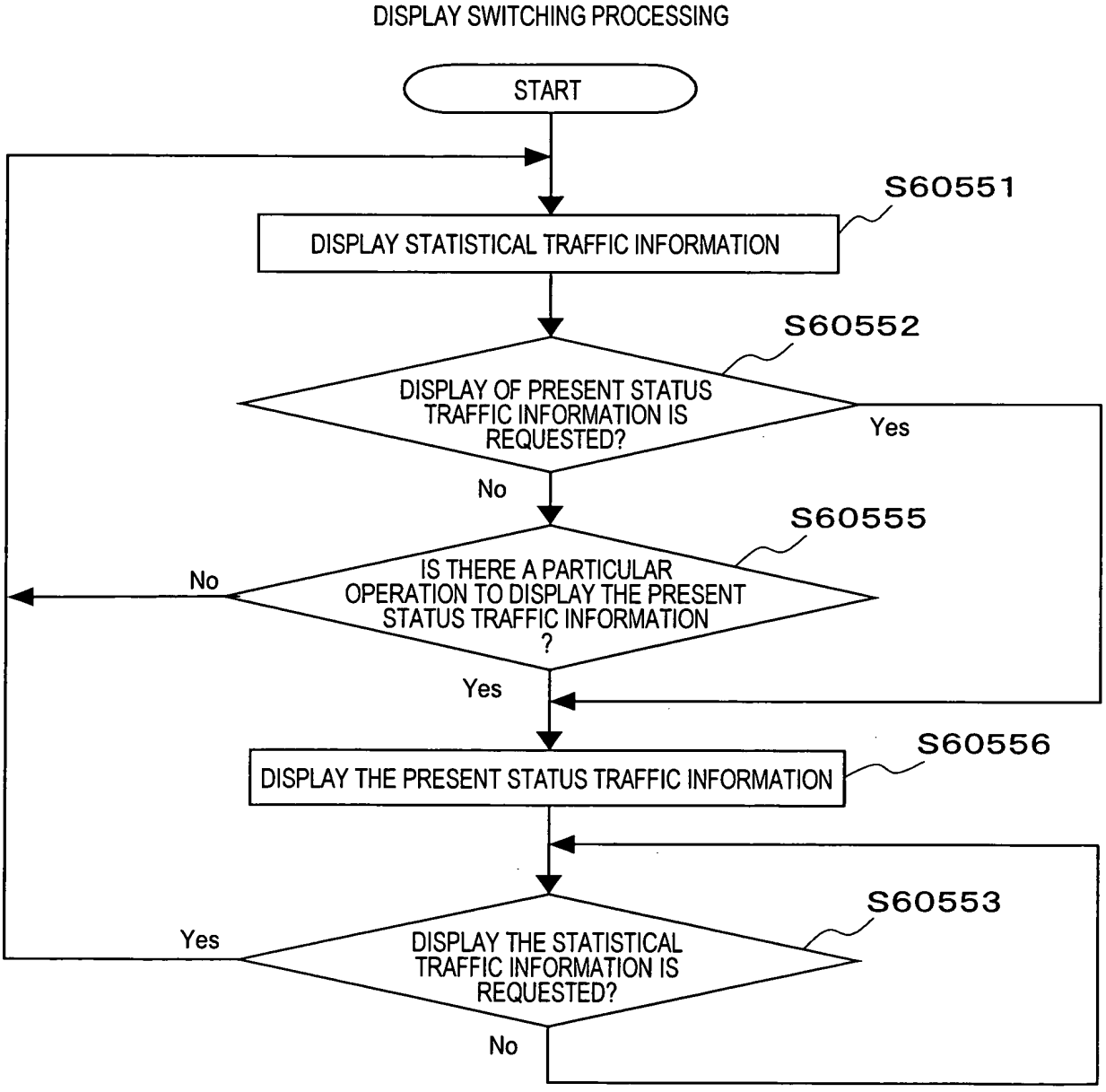
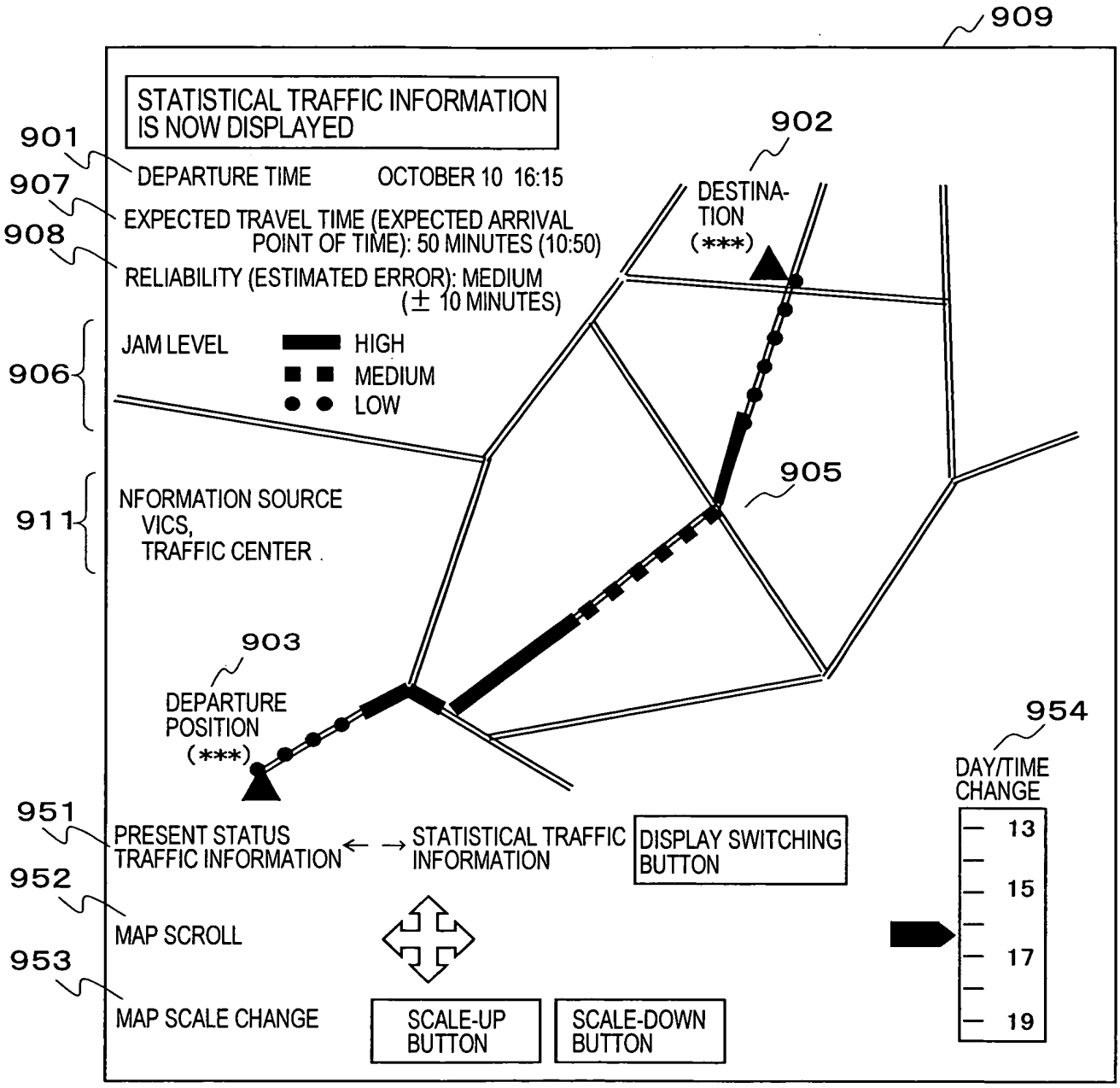

DISPLAY SWITCHING PROCESSING
START
S60551
DISPLAY STATISTICAL TRAFFIC INFORMATION
S60552
DISPLAY OF PRESENT STATUS TRAFFIC INFORMATION IS REQUESTED?
Yes
No
S60555
IS THERE A PARTICULAR OPERATION TO DISPLAY THE PRESENT STATUS TRAFFIC INFORMATION ?
No
Yes
S60556
DISPLAY THE PRESENT STATUS TRAFFIC INFORMATION
S60553
DISPLAY THE STATISTICAL TRAFFIC INFORMATION IS REQUESTED?
Yes
No

FIG.26


909
STATISTICAL TRAFFIC INFORMATION IS NOW DISPLAYED
901
DEPARTURE TIME OCTOBER 10 16:15
907
EXPECTED TRAVEL TIME (EXPECTED ARRIVAL POINT OF TIME): 50 MINUTES (10:50)
908
RELIABILITY (ESTIMATED ERROR): MEDIUM (± 10 MINUTES)
906
JAM LEVEL
HIGH
MEDIUM
LOW
911
NFORMATION SOURCE
VICS,
TRAFFIC CENTER
902
DESTINA-TION (***)
905
903
DEPARTURE POSITION (***)
954
DAY/TIME CHANGE
13
15
17
19
951
PRESENT STATUS TRAFFIC INFORMATION
STATISTICAL TRAFFIC INFORMATION
DISPLAY SWITCHING BUTTON
952
MAP SCROLL
953
MAP SCALE CHANGE
SCALE-UP BUTTON
SCALE-DOWN BUTTON